

Aviation Week & Space Technology

March 25, 1963

SPECIAL REPORT:

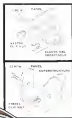
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Reduce installed fastener cost—reventing is eliminated. Kaylock clip-on nuts, both flanging and non-flanging are useful in secondary structure and non-structural aerospace applications and electronic packaging.

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The Kaylock clip-on nut has the famous patented elliptical locking device and meets requirements of MIL-N-28487 for self-locking, torque-out and strength. Write today for Bulletin 2848



P1004



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... located between the tread rubber and the tire carcass. Protects carcass from cuts, keeps seal cuts from growing. The Payoff: Tires preserved for re-treading (often as much as 7 times) ... early tire failures virtually eliminated ... equipment efficiency increased.

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AEROSPACE CALENDAR

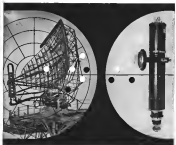
(Continued from page 5)

- Engine Meeting, Cluster House Hotel, Anaheim, Calif.
- Apr. 30-El Segundo Valley Instrument Automation Electronics Exhibition & Symposium, Cincinnati Gardens and Cincinnati Inn, Cincinnati, Ohio.
- Apr. 16-18—National Meeting, Aerospace Industries Ass'n., Export Committee, Cranston Inn, Washington D.C.
- Apr. 16-18—Optical Mirror Symposium, Wilford Astor, New York, N.Y. Symposia: Polymeric Materials of Analysis, IEEE, American Optical Society, Annual Meeting.
- Apr. 16-19-1963 USAF Aerospace Fluids and Lubricants Conference (continued), San Antonio, Tex. Managed by South West Research Institute.
- Apr. 17-19—Annual Technical Meeting and Equipment Exposition, Institute of Environmental Sciences, Sheraton Hilton Hotel, Los Angeles, Calif.
- Apr. 17-19—International Nuclear Magnetic Resonance (INTERMRM) Conference, Institute of Electrical and Electronics Engineers, Sheraton Hotel, Wiesbaden.
- Apr. 17-19—Southwestern Conference and Electronic Show, Institute of Electrical and Electronics Engineers, Dallas Municipal Auditorium, Dallas, Tex.
- Apr. 17-19—Technical Meeting Nuclear Materials for Space Applications, American Nuclear Society, Sheraton Hilton Hotel, Cincinnati, Ohio.
- Apr. 22-23—Annual Meeting, National Astronautical Society, Astor, Midway Hotel, D.C.
- Apr. 22-24—Second Manned Space Flight Symposium, AIAA/NASA, Marriott Hotel, Dallas, Tex.
- Apr. 22-24—Third Annual San Diego Symposium for Aeronautical Engineering, Del Webb's Desert Inn, San Diego, Calif.
- Apr. 24-27—Hydraulic Research Conference, AIAA/ASME, Naval Ordnance Laboratory, White Oak, Md.
- Apr. 21-23—National Conference on Electromagnetic Interference, Oklahoma State University, Stillwater, Okla.
- Apr. 25-26—Annual Convention, Society of Automotive Value Engineers, Americana Hotel, New York, N.Y.
- Apr. 29-May-1963 Spring Meeting, Western States Section/The Combustion Institute, Vacation Village Motel, San Diego, Calif. Sponsor: General Dynamics/Aerospace.
- Apr. 29-May 1-1963, Annual, Scottish Meeting, Aerospace Meeting Ass'n., Sheraton Hilton Hotel, Los Angeles, Calif.
- Apr. 29-May 2-23—Annual National Conference, Society of Automotive Weight Engineers, Sheraton Jefferson Hotel, St. Louis, Mo.
- Apr. 29-May 2-3—Spring Meeting, United States National Committee of International Scientific Radio Union (USNR), National Academy of Sciences, National Research Council, Washington, D.C.
- Apr. 19-May 1—Annual Conference, Society of Photographic Scientists and Engineers, Ambassador Hotel, Atlantic City, N.J. Co-sponsor: Army Research Office.
- May 1-1963—Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D.C.

(Continued on page 9)

Point amplifier systems, with a history of reliable long life performance in early warning systems, are part of the extensive line of Litton microwave tubes and display devices, San Carlos, California, Europe Box 110, Zurich 50, Switzerland.

LITTON INDUSTRIES
ELECTRON TUBE DIVISION



PROBLEMATIC RECREATIONS 163



Two cubes with integral sides have their combined volume equal to the combined length of their edges. What are the dimensions of the cubes?

—C. S. G. H. H.

If you're in New York this week attending the IEEE Convention, we advise you to meet members of our Data Systems Division at the Statton Hotel Cater Center. The conversation should prove interesting if your experience has been in any of the following systems: command and control, air defense, air traffic control, ASW, reconnaissance and surveillance, and display. Ask for Mr. Myle Langman at the Statton. You can register by phone.

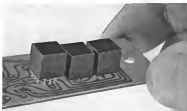
ANSWER TO LAST WEEK'S PROBLEM: Each cube represents an alloy of $13 + 10^{10} + 10^{10} + \dots$ where $v = \frac{1}{10}$ or \$25.90, if the tiles are treated the corresponding alloy per lb will be $14 + 14^{10} + 14^{10} + \dots$ or \$26.95. Therefore, it is more economical not to treat the tin.

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New RCA Digital Micro Circuits Switch in 7 Nanoseconds

First of three of compact high-chipsets—the RCA 68C100 uses advanced silicon elements for ultra-high speed and new design flexibility. The RCA 68C100 offers excellent noise immunity, switch (up speeds) to seven nanoseconds, high operating reliability and low power dissipation. The RCA 68C100—designed for use in gates, adders, flip-flops, shift registers and multiplexers—is now available for immediate delivery.

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The Defense Dollar: Who spends it? Who gets it?

The obvious answer to the first question is government, of course. In the next fiscal year, over 23 billion defense dollars will be spent by the government on contracts for the goods and services of U.S. companies.

But government is not the only customer for the defense markets. Industry itself is the other important customer. And, for many thousands of companies, industry is the most important customer.

Consider these facts: Only 506 U.S. firms—the leading defense contractors—account for three-fourths of the dollar value of all new defense contracts. Yet half the dollar value of prime contracts in sub-contractors more than \$11 billion in 1963. It is

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Business Week reaches 8,156 high-level government subscription entry points. (Your Executive Vice President Manager will be glad to show you a list of their names.) *Business Week* also reaches management executives in every one of the top 500 companies doing defense business with the government 38,266 individuals—an average of 563 Division

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With the industry's widest experience in metal-to coatings, LINDE's Complete Custom Coating

Service has the answer to your "hot" wear problems—regardless of the base material, size, or configuration of the piece involved. If the answer isn't on our shelf—we'll research to get it.

Many of today's important aerospace parts have successfully used Flame-Plated coatings—such as the combustion chamber of the Apollo satellite rocket engine, aircraft valves, compressor blades, turbine engine nozzles, rocket nozzles, and many others. For many industrial parts, LINDE's "prescription" coatings have increased service life as much as 40 times!

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EDITORIAL

Military Space Program

[Air Force Secretary Eugene Ruckelshaus presented the following picture of the evolving military space program in a recent speech at the Air Force Studies Test Center at Cape Canaveral, Fla. Reviewers of the recently shifting pattern of top-level Pentagon attitudes on the role of the military in space, we are presenting excerpts from his remarks.—Ed.]

While we still have to do all the old jobs assigned to us, we have the difficult, demanding, challenging, and expanding new job to do in space.

Before I say anything about our future in space, let me establish two bench marks. The first is that the Air Force wants everything it can get from NASA. NASA needs us, too, as the crowd of how NASA puts things into space indicates, but if there weren't a NASA, the same facility and capability would have to be created some other way.

There is something precedent for the principle of having an outside of defense civilian agency provide the type of support we need. The case at point is the Atomic Energy Commission. Our own atomic weapon facilities, as well as the Polaris-carrying submarine without instance.

The clear lesson for us in the space field is that we must put requirements on NASA to meet what is just out of our needs can be met in this way. We must utilize every possible resource to build the necessary military capability and I can assure you that NASA is ready to respond. Jim Webb, the NASA Administrator, has been no slacker about NASA's responsibility in support of national defense requirements.

The second bench mark is that there is no such thing as peaceful space or military space. There is just space. A new and massive space program in a civilian agency was launched nearly five years ago, with—for reasons which seemed not unreasonable at the time—a great hesitation about peaceful objectives.

USAF Space Goals

The nation is holding to these peaceful objectives, but we also know that the military services will have to do the same thing in space that they have always done in the media of the land, sea and air. The Air Force forward space program is, therefore, aimed at two great end objectives.

The first is to acquire the capability to utilize space in support of the military forces operating in the familiar environments of land, sea, and air. Space offers new and Observations warning, communications, military guidance and reconnaissance are seen for the application of space technology to defense. All of the services have requirements of their own and it is up to the Air Force to

provide them the access they need for their purposes. The secretary of defense has assigned the responsibility to us.

Let me caution against letting any inter-service differences blur judgment or vision. It is my position that competition in ideas among the three services is desirable. The imaginative, straggled people we need in this business are going to have differences, and they must be resolved constructively.

Our second general objective is to acquire the necessary defense capability for the aerospace against themselves. We must be able to protect the peaceful activities in space of the nations of the free world. We believe that space can be free to all for peaceful activity only if somebody keeps it free. We are that somebody. The job involves monitoring the space environment in order to deny to a hostile power the unbridled military exploitation of space. We can only do this if we have the ability to detect and counter any military threat. We believe that both manned and unmanned systems will be required, but we cannot say now in what relative investment.

Lesson of Gemini

We have a lot to learn. The recent agreement with NASA for joint participation in the Gemini program is one way. That agreement represents an answer from both DOD and NASA to critics who said there was no place in space for military man. Our own activity directed toward manned space vehicles will increase, and with NASA's backup, we'll attain the needed capability earlier than we would otherwise.

A lesson you hear around Washington to denote the need of cooperation between government agencies is "interface." Here at Cape Canaveral is one of the primary "NASA Air Force interfaces." Such terms usually leave me pretty cold, but this one does have some descriptive value.

There will be plenty of problems between the Air Force and NASA, but not by any means all at the "interface" points such as the Cape. We wouldn't rather be true to trust or tradition if there weren't. Any machine as big as the national space effort is bound to have some kind of friction. But just remember, a clutch is a friction interface. Its purpose is to put two shafts for the transmission of power.

The power we can get will provide protection for the free world in space. This is my third point—to make sure that no aggressor can exploit space, either for expansion on earth or interference in space with the peaceful pursuits of the free world.

Cost effectiveness in MISSILE SITE SUPPORT?



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Kaman helicopters purely and simply can provide maximum effectiveness in the Defense Program dollar... and they're in the ready inventory to provide USAF with logistic support in being, plus hundreds of USAF pilots and mechanics trained in type. **Mission Reliability**—Using proven dynamic components, Kaman helicopters have the best record of safety and dependability of any USAF helicopters...lowest accident rate...hold world's records for distance, altitude and payload established by USAF pilots...reliability maintenance...3900 hour dynamic components... **Productivity**—Based on factors of range, speed, payload and altitude, Kaman helicopters can provide the most favorable ton/mile factor of any helicopters in their class... **Multi-Mission Capability**—In-the-field convertibility from cargo to passenger to litter configurations with equal mission reliability...practical rear door loading of unobstructed box-type cargo...from every standpoint, Kaman helicopters are the best buy for missile site support or multi-mission reliability.

WHO'S WHERE

In the Front Office

Dr. Charles C. Lindholm, President Emeritus of Phoenix is the California Institute of Technology, created a director of Hycon Mfg. Co., Mountain View, Calif.

Col. Edward A. Friedlander (USAF, ret.) has been named manufacturing director, evaluation and consultant for Force for General Electric Co.'s Defense Program Operation, with office in Washington, D.C.

Dr. David K. Frosch, former technical associate director of Los Alamos Scientific Laboratory, has joined the scientific directorate of Douglas Aircraft Co., Santa Monica, Calif.

Edwin E. van Brockhoff, vice president and treasurer of Hecht-Pickard Co., directed a director of Melroe, Falls Air, Calif.

Howard A. Rosen, president, Scott Air Tool Corp., Lancaster, N.Y., succeeding Edie M. Scott, who continues in chairman and chief executive officer.

Vice President Peter T. Angell, second general manager of the Tropic Div. of Thompson Radio Warrington, Inc., Cleveland, Ohio. **Dr. William A. Johnson**, senior vice president in director of research, development and engineering, Tropic Div. of William A. Johnson, Inc., Waukegan, Ill. **Robert Corp.**, Clark Vito, Calif., and **Frank E. McCreary**, former vice president engineering, now vice president manufacturing, K.W. Gabel, chief engineering.

Edward V. Marshall, division vice president in charge of the newly formed Space and Life Sciences Dept., Hamilton Standard Div. of United Aircraft Corp., Windsor, Locks, Conn.

L. Wayne Melton, vice president/technical director, General Electric, Santa Clara, Calif.

Dr. William M. Davis, Jr., vice president, International Telegraphic Corp., New York, N.Y., and group vice president of U.S. Defense Inc. (U.S. Defense Associates) in Dallas in president of ITT Federal Labs (AW 10-7, p. 21).

John T. Soy, vice president and a director in Rocket Jet Engineering Corp., Glendale, Calif.

John L. Segal, vice president operations, Douglas Aircraft Co., Space Systems Div. a Space Systems Group, Huntington Beach, Calif., and responsible for general management of the area facility.

Dr. Albertine P. Sullivan, Dean of the Institute of Technology, University of Maryland, has been elected a member of the Board of Directors of Aerospace Corp., Los Angeles, Calif.

John W. Gajda, vice president/technical director, Fairchild-Coughlin, Inc., San Jose, Calif.

Joseph M. Hanson, vice president/technical director and marketing, Utah Div. of Gen. and Precision, Inc., San Jose, Calif., and Gen. and Precision, Inc., San Jose, Calif.

Robert W. Scholten, vice president Western region, American a division of North American Aviation, Inc., Los Angeles, Calif.

James E. Gahan, vice president finance, General Inc., Springfield, Calif.

Donald Kinsinger, Jr., vice president and treasurer, The West Corp., Bedford, Mass.

Edward D. T. R. Puck, president (Continued on page 18)

INDUSTRY OBSERVER

► Second Atlas-Centaur with powered upper stage is scheduled for launch in July or August by the National Aeronautics and Space Administration. Primary objectives of the flight will be determination of separation system performance and structural integrity. Pratt & Whitney RL10A-1 power plant will be utilized prior to liftoff with liquid hydrogen down flow flight loading, a technique extensively tested at General Dynamics/Astronautics' Space Shuttle test and believed adequate for initial Gemini flights. GDA and NASA's Launch Research Center are considering alternate checkout methods for flight profiles involving engine control and coasting periods between re-ignitions.

► First manufacturing for the Gemini, post-Apollo/Finch spaceport transport project, is scheduled to begin next month. Observers of the program report smoothly working at all levels, despite the currently strained relations between the two countries.

► First flight of the Northrop X-21A low-altitude control aircraft is scheduled Apr. 25, when the airplane will be flown to Edwards AFB for the start of its maneuver flight test program. First test flight in the program is expected to be made about mid-May by a Northrop crew. Both test aircraft will be parallel programs, with about seven months overlap. Company will demonstrate a complete program of flow control and associated tests, including maintenance of low-altitude flow during bad weather flying.

► Joint Egyptian-Indian production of aircraft is being discussed by high government officials of both countries. Egypt plans to place plant at Helwan on production of the concept and Hindustan Aircraft Co. will manufacture. Teams of Egyptian and Anglo-German engineers went to India recently for detailed discussions with Indian engineers.

► Weight of Cessna's new Model 441 has been moved up 11 in. in a major change in this in-engine branch aircraft now under development (AW 10-7, p. 22). Target for commercial market introduction is late 1964.

► Balise prototype for the F-4 Phantom II VTOL strike-fighter being high-speed flight tests this week from Melroe/Melroe aircraft after being fitted with retractable landing gear. Balise aircraft are under development by General Aircraft/Melroe/Melroe. Balise is a modified Phantom II prototype, with its original Phantom II cockpit replaced by a single dorsal cockpit and a battery of eight Balise-Boeing RB-108-101 engines.

► Aeronautical is interested in development of plasma-sensor materials to protect and monitor of helicopter rotor blades. Kits would be supplied for installation in areas where sensors are an operational problem. Recent tests on a Bell UH-1D showed only slight wear after 140 liftoffs and landings among blades protected by Goodrich infrared absorbers and flame landing, older blades, which were damaged and cracked after 100 liftoffs and landings at the Army's Yuma, Ariz., test station. Van't type determined afterwards after 12 liftoffs and landings.

► Aeronautics 708 is probably now saved in the two-man Gemini spacecraft by NASA's choice of aerodynamic parameters, rather than hydrogen peroxide, for the aerodynamic control system. Spacecraft performance will be advanced by an independent battery and power bus to eliminate voltage transients across relays and buses connected solely in Gemini flight.

► Shephard West version of the USAF's aircraft transport powered SLAM stands in one of several advanced technology studies by Chance-Vought Associates at Mountain View. Other systems include a subsonic-boosted defense aircraft, a short bombardment aircraft, and a subsonic-boosted aircraft capable to launch out enemy air defense network.

► Technical feasibility of an Army air defense system for 1970 (AD670) is proposed to be investigated under four \$250,000 contracts to be started in May. Requests for proposals are expected later this month. Program is a supplement for the Field Army Ballistic Missile Defense System.



Technicians complete the construction of a communication satellite thermal model in the Bendix 20" x 20" vacuum chamber by connecting thousands of leads to a vacuum panel. Tests verify the thermal behavior of the configuration in outer space conditions. The satellite shows the strategic location of electronic equipment and thermal coatings at critical areas to protect satellite temperatures without mass necessary to provide maximum operating efficiency.

KEEP IT SIMPLE . . . Build it. Test it. These are the rules for reliable spacecraft development and successful system integration. This development philosophy plus complete facilities at the Bendix Systems Division support major programs from concept to flight test to fulfill tomorrow's needs in satellite communications. Engineers seeking career opportunities in the space field are invited to contact our Personnel Director, Bendix Systems Division, Ann Arbor, Michigan — An Equal Opportunity Employer.

Bendix Systems Division



**WHERE IDEAS
UNLOCK
THE FUTURE**

Washington Roundup

Military Space Quiz

Maneuver space flight subcommittee of the House space committee will press Defense Dept. hard for a statement on whether it believes there is a military mission in space and if so, what the mission consists of. The subcommittee has tried this each year but has never been completely satisfied with the answer it got. Chairman Otto Frege believes the military services should have a larger role in the national space program but has said that he does not believe the Defense Dept. has spent out the need very well. So the questions will be asked again, in closed hearings if necessary, probably next month.

Next area of space cooperation to be explored by the U. S. and Russia is the study of the earth's magnetic field by satellite. NASA's Deputy Administrator Hugh L. Dryden and Russia's Anatoli A. Blagovestov last week completed detailed negotiations on non-governmental and satellite agreements. First joint experiment will involve Echo 2, as preferred by American Werners & Neugebauer last Dec. 3 (p. 25). It will be launched in late summer or early fall. Whether satellites will be launched by each country, an difficult debate, probably beginning next year, and new ones will be launched to maintain the program going. The two scientists agreed that political considerations prohibit U. S.-USSR cooperation in manned lunar flights. Asked which country would get there first, Blagovestov said "It's like a horse race."

Russian Rendezvous

At least a possibility exists now that satellite space missions may eventually be staged by the two nations. Gemini capsule and the N-15 glider (see p. 22). But Russia, which began exploring rendezvous techniques last summer, has done so far another two years without results from the U. S.

First manned flight in a Soviet capsule cannot be made before early 1964, and mid-1964 looks like a better bet. Gemini flights originally were scheduled for even, two months but one flight every three months is now considered to be a more realistic schedule. That means no attempt at rendezvous would be made in Gemini until 1965. The assigned Mission Specialist, Chief of NASA's Manned Spacecraft Center in Houston, Tex., is critical to the rendezvous mission, and it will not be made until 1965.

Manned Gemini flights, in which the Air Force will participate, begin with the second test. Flights three and four will be two weeks long. Flights 5 through 12 are now scheduled to be two-week flights.

Another Fare Flap

Second disapproval by the Civil Aeronautics Board of international air travel agreed upon at the International Air Transport Association conference in Montreal, New York, is a clause in a postwar treaty between the U. S. and the Soviet Union. The agreement would have caused the United States to increase on North Atlantic routes by doubling the discount for round-trip tickets. CAB's action is being viewed abroad as a heavy-handed unilateral action by the U. S. and has raised the issue of diplomatic levels. It also will prove to be the first test case of the new U. S. international air transport policy, which calls for lower fares, and which has not been approved by President Kennedy.

Felix Philippson, head of Chicago, is confident that it will win NASA's approval for a contract giving field exclusive rights to personnel stores of the 16 astronauts. The firm is having a legal opinion to explore the contract. Speculation is that the contract will pay the astronauts a total of \$1 million through the Gemini and Apollo programs.

D. F. Ottavio, an engineer and former member of committees and members of defense industry, has been selected to lead deputy chairman of the U.S. Council of Ministers and head of the USSR Supreme National Economic Council, Leonid Smirnov, until now head of the State Committee for Defense Technology, Russian deputy chairman of the ministerial council.

Military Commit Funds

Defense Dept.'s military communication satellite program is making up against congressional piling demands. Unless Defense can change course thinking is Congress, as Fiscal 1964 budget request of about \$60 million will be deferred on the basis that Fiscal 1963 funds originally appropriated for the new defense Project Advanced communications satellite program will be sufficient to support the new program in the coming year. Some lawmakers also question the need for a separate military communication system.

NASA's announcement that the New England Div. of the Army Corps of Engineers has been selected to assist in the design and construction of the proposed Electronics Research Center in the Boston area comes in a surprise to some members of the House space committee who have questioned the need for the center (AW Mar. 4, p. 25). NASA issued committee members that work would not be started until the world 55 airline construction fund request had been approved by Congress as part of the fiscal 1964 budget.

TXF activities, which began in a privately held Capital Hill investigation of a complicated procurement division, has now reached such proportions that Pentagon maps are offering to the TXF as "Cerebral." —Washington Staff

Soviets Flying Electronic Ferret Missions

Modified Bears make nine passes over U. S. carrier; four aircraft were involved in latest Pacific incident.

By Lees Rood

Washington—Hawaii notified Soviet long-range bombers that have been making reconnaissance flights over U. S. aircraft carriers in the Atlantic and Pacific recently have electronic intelligence, or eavesdropping, as their primary mission. This appears to be the first time that such aircraft, with one plane acting as a "spotter" to locate a ship by its electronic signature and the other as a "subfinder" to read the aircraft in the carrier.

In the latest incident, loss of the intelligence T-102 Bear reconnaissance made a total of nine passes over the carrier Constellation 680 mi south of Midway Island in the Pacific on Mar. 25. This is the first appearance of modified Bears in the Pacific to be reported by Defense Dept. At least two of the four were the same aircraft that flew over the carrier Enterprise and Forrestal in the Atlantic last month (AW Mar. 4, p. 2).

The two Soviet aircraft which generated U. S. interest over Alaska on Mar. 15 also have been almost definitely identified as Bears. Until early this year, only short-range aircraft up to and including the medium-range turbojet-powered Tu-16 Badger had landed near reconnaissance flights. Before they over the Ketchikan on Feb. 27 and Feb. 3, and the Princeton on Feb. 15 and 16, and the T-102. These reconnaissance flights involved the Tu-16 Bear's long-range bomber.

U. S. officials believe that Russia now has only a few Bears modified for electronic intelligence (Eliot) and photo-graphic reconnaissance missions. The first version modified to carry electronic intelligence equipment has the primary electronic equipment, except for a radio, in a low, high speed and high frequency reconnaissance.

The long-range Tu-16 Badger, which carries a large, long-range radar as a main defense. This radar housing is called a "subfinder" and the Tu-16 is the Bear's "spotter." The Tu-16 is the Bear's "subfinder." This type also is equipped

for photographic reconnaissance use. In the flights over the carrier, the Bears were reported to have flown at low altitudes, about 10,000 ft, and to have flown at low altitudes.

It is possible that the carrier is present electronic equipment. This is known as "Eliot" for modified Tu-16. Its primary purpose is to receive that aircraft and to make even that at sea appear to be as big as a carrier on a radar screen.

Nine missions were made about 193 mi from the Ketchikan Island in the northern Pacific in January and February. The Bears were reported to have flown at low altitudes, about 10,000 ft, and to have flown at low altitudes.

High Navy officials attribute the most likely use to an increased desire by the Russian leadership to increase their power over the western world.

Some high Navy officials are claiming that the first appearance of the Bears in the Pacific is a result of the fact that the Bears are now being used in the Pacific. The Bears are now being used in the Pacific. The Bears are now being used in the Pacific.

This also would be to use them to eliminate bearing on the carrier. This has not been done so far for aircraft carriers.

In the first incident over the carrier and Enterprise, flights two aircraft were detected Mar. 15 approaching the south western part of the Alaska mainland before 9 p.m. in Alaska time. The first passed into U. S. territory at 9:07 p.m. and the second at 9:11 p.m.

The path of the two aircraft were of great interest, describing a gradual turn to the north at a speed of 900 kt. at 9:00 p.m. The first aircraft left U. S. territory at 9:36 p.m. and the second at 9:41 p.m.

When the aircraft were first detected the Air Defense Command sent an Alaska's Galena Airport was alerted and a flight of F-102 fighters was dispatched. The two Soviet aircraft passed over land directly west of Ketchikan Bay on a north heading and swung around to the west, leaving the southeast of Hoonah Bay just south of the mouth of the Taku River. The reconnaissance mission was 10 mi.

The area involved has east of Nootka Island, south of British Columbia and the Alaska Peninsula and east of the Puget Sound located in the eastern Bering Sea.

The T-102 aircraft intercepted the flight in bad weather. The Soviet aircraft took no evasive action and, after the intercept took place at a point where it was obvious that the carrier was heading, the Bears turned to the south and flew in a southerly direction.

From the operating characteristics of the aircraft it was determined that they probably were Bears.

Admission officials consider the appearance of the Bears in the Pacific as a significant development, rather than as a threat because the Tu-16 aircraft is equipped with radar and other devices which would permit accurate navigation. On Mar. 16, the U. S. State Dept. protested the flights and said it expects Russia to "take all necessary steps to prevent any repetition."

The flight that concerned the Constellation was detected more than 200 mi away. A flight of two Tu-16 aircraft, one of which was a Tu-16, was detected by the Constellation's radar. The flight was detected by the Constellation's radar. The flight was detected by the Constellation's radar.

The Bears made a total of nine passes over the Constellation, two of which were at 24,000 ft and seven at less than 10,000 ft.

The Constellation was on its way to Subic Bay, The Philippines, from Pearl Harbor, Hawaii. The route taken was a Great Circle course covering the least distance between the two points.



First photo of Navy's SM-47 Shillelagh took mounted anti-aircraft missile shows the complex evaluation steps of development rounds. Missile is fired from a gun launcher mounted in a tank turret and is accelerated by a single solid propellant rocket apparatus discharging through a gun of control rockets (center photo).

Shillelagh Firing Shown in First Photos



Two sets of four up mounted anti-aircraft missile show the complex evaluation steps of development rounds. Missile is fired from a gun launcher mounted in a tank turret and is accelerated by a single solid propellant rocket apparatus discharging through a gun of control rockets (center photo).



Military Missions for X-20, Gemini Under Study

Washington—Possible military space missions involving new defense agencies and military will be studied by the USAF Boeing X-20 (Dyna-Soar) program and the National Aeronautics and Space Administration McDonnell Douglas program against the introduction of the new program.

The studies are an outgrowth of Defense Secretary Robert S. McNamara's visit to the Boeing Co. plant at Seattle, Wash., and NASA's Human Spacecraft Center at Houston, Tex., on Mar. 13 and 14. McNamara has decided to prepare for at least six months to develop in test beds in the X-20 as he sought to test the Gemini program. He returned before the House Armed Services Committee recently. McNamara and others appeared to have criticized the X-20 and said that it is not to be tested (AW Mar. 15, p. 31).

Guidelines for the military mission are under review, according to the report. The report is to be sent to the Secretary of Defense, Dept. of Defense. This is the first time the report has been published since it was first written. The change in McNamara's attitude indicates increased support of a military mission in space flight. The last news in this direction was the recent inclusion of the X-20 in NASA's Gemini program. The degree of the force program has not yet been determined.

But the House Armed Services Committee has decided on engineering, and its industrial base has decided that Gemini can do the military space job as well as the original X-20.

During the Boeing visit, McNamara, NASA officials and others

discussed military use of the X-20 and considered the role of the X-20 in the military mission. The report is to be sent to the Secretary of Defense, Dept. of Defense. This is the first time the report has been published since it was first written.

It is up to the X-20 to determine the role of the X-20 in the military mission. The report is to be sent to the Secretary of Defense, Dept. of Defense. This is the first time the report has been published since it was first written.

The question facing the X-20 program is whether the program of knowledge of the X-20 program is worth the \$100 million that will have been spent by the end of 1967 and the \$125 million that has been reported to test 1964. The total reported program is estimated to be \$100 million.

Testing and development of parts for construction of the Boeing X-20 is under way. The report is to be sent to the Secretary of Defense, Dept. of Defense. This is the first time the report has been published since it was first written.

The X-20 is to be used mainly as a test bed for the X-20 program. The report is to be sent to the Secretary of Defense, Dept. of Defense. This is the first time the report has been published since it was first written.

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MiG-17 Shown With New Modifications

Unconventional weapons and fuel tanks and a modified air intake characterize the modified version of the MiG-17 in service with the Russian air force. Weapons resemble the Vozok-Bellamy air-to-surface missile but are smaller, longer and apparently a usual geometry with small canards forward and fins aft. Until MiG-17 aircraft of 25 mm, cannon appear to have been removed from this version, possibly to allow operation of the jet in hostile, the air blocked out by the release in the center. Can covers in small housing on airframe side of inlet. Over 15,000 MiG-17s were delivered to Russian units, satellite countries and nations friendly to USSR.

Key UN Space Group Meetings To Be Held in New York, Geneva

United Nations, N.Y.-United Nations Committee on the Peaceful Uses of Outer Space agreed unanimously last week in kind as Legal Subcommittee meetings in New York, and its Scientific and Technical Subcommittee meetings in Geneva this spring.

Location of the meetings had been the subject of a three-week behind-the-scenes debate with some cold war overtones. Before agreement was reached among members.

Last meeting, strongly by Soviet member Dr. N. T. Fomenko to have the committee, decline the New York meeting "an exception" and no precedent for the future was seen by observers as an attempt to downgrade the U.S. as a focal point for international space matters. Soviets would have had both meetings to be held in Geneva. Last year both subcommittees met in New York. The issue was resolved by entering the Soviet statement in the UN official record without the declaration.

Legal Subcommittee is expected to

resume debate on formulating general principles for space exploration and actual legal problems after failure to reach agreement last September (AW Dec. 10, p. 10). Meetings are scheduled Apr. 16-May 7.

Technical Subcommittee, to meet May 14-31, will consider suggestions outlined in a United Arab Republic statement circulated among committee members last week. Statement calls for an outline of main ideas, technical assistance could be rendered to countries wishing to enter space research, taking into account varying levels of technological achievement.

Technical Committee would also discuss on priorities and types of assistance to be made available to developing countries. Matters of training nationals of these countries as a vital part of their work also be considered.

Soviet member Fomenko and the housing of nationals in space research was mentioned linked to issues of air travel security in the committee, but the Soviet Union would consider training

on a bilateral basis with industrial countries. U.S. ambassador departs representative France (Shannon) and the subject of training remained study.

In other space committee action, the recommendation of India proposing establishment of an Equatorial Launching Rocket Launching Facility in Kavaratti, Setra, near Thiruvananthapuram for UN sponsorship was welcomed by the committee. Remaining procedural steps before UN sponsorship include a program report due before the space committee and General Assembly vote.

National Aeronautics and Space Administration will launch four Nike Cosmos vehicles and an appropriate launching device in accordance with a memorandum of understanding with India signed last October. India's Dept. of Atomic Energy will supply and/or vapor release probes for optical tracking of upper atmosphere wind currents in conjunction with a brief study of the equatorial electrodyn in the atmosphere.

For the electrical experiments, NASA will provide state Nike Apache vehicles and loan launch, tracking and telemetry equipment. India will launch personnel for launch tracking and data analysis. Both experiments are scheduled for 1963.



3-4 C-141 painting for CECO by R. T. Chandler

CECO fuel pumps chosen again. Lockheed's giant turbofan fighter, the C-141 Starlifter, will be powered by four P&WA 21,000-pound-thrust engines equipped with fuel pumps engineered and precision-graduated by Chandler Evans.

Our product on the C-141 joins a distinguished line of pumps in military and commercial applications. Continuously certified for three thousand hours between overhaul, CECO fuel pumps have completed more than six million service hours with Pratt & Whitney Aircraft and General Electric turbojet engines.

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Industry Protests Increased Data-Sharing

Washington-Inclusion of broader "give-away" claims in defense contracts, which would require the contractor to develop a product to share proprietary data, equipment, "know-how" and trained personnel if any part of production is assigned to another firm, has come under attack of three industry associations.

Aerospace Industries Assn., National Security Industrial Assn. and the Electronic Industries Assn. have written letters and made personal protests to Defense Dept. officials objecting to data requirements included in contracts for the F-15H (TFX) fighter, tactical fighter, the Navy's supersonic turbo-prop engine (X-45) and the Navy's EX-10 torpedo.

One industry official described the new clause as forcing the development contractor that he "must be ready and willing to put another company into business with the product he developed and then guarantee the results for an indefinite period of time."

In September, 1961 the Aerospace Industries Div. of the Air Force Systems Command made the first attempt to include the requirement in the first requests for proposals (RFPs) on the TFX. Last summer the Navy followed a similar procedure for its version of the TFX.

The Navy then applied it to the EX-10 torpedo and the supersonic turbo-prop engine proposal requests.

Protests followed for including such a clause in a contract to sub-contractors of defense for a contract to the Armed Services Procurement Regulations (ASPR). In each instance the deviations proved so much faster than the ASPR.

One Navy spokesman said it wants to avoid a production contract to involve a change. The policy is not yet fully understood in the Navy is illustrated by the early cancelling the awarding of RFPs on the supersonic turbo-prop engine development for the engine Feb. 21. No revision was made of any deviation from the ASPR.

But that each of the companies received preliminary Feb. 12, an amended RFP which included an embargo on the data on the development of the engine.

The document states that a government contractor who can make a contractor to furnish engineering and other technical assistance in the form of loaned personnel, the assistance and product of government personnel or the personnel of a third party, sign data letters or provide training and other assistance, information, rights or licenses.

The contractor can request compensation for second party of training data and other technical assistance for which the government has not and has provided. But he will not be considered for technical assistance, training or loaned personnel in loan or subcontracting.

The contracting office can also order the contractor to furnish data in third and second party of contract development or provide engineering and other technical assistance and to the public contractors. If the data or service is used to develop the new product under the contract.

However, the contractor will not be able to sue for own proprietary data or specially-developed items without first seeking permission to do so. Then the industry associations maintain such rights for the benefits of proprietary and patenting, necessary to make the contract.

A data package furnished to the government for use in whatever way it sees fit has no specific information on any of all of the design approach (evaluation, quality assurance (including inspection), project management or maintenance of specific parts, controls, test, training, operations, maintenance, repair and overhaul, manufacture, failure and overhaul (when not producible contractually), maintenance at

a government activity and competitive replacement from industrial sources, modification and deterioration of government rights.

Industry groups agree that government members that these deviations to the ASPR across, rather than otherwise, data problem.

In a May 1 letter to Assistant Secretary of the Navy for Installations and Logistics Kenneth Belton, George P. Thompson was president of Aerospace Industries Assn. said the deviation as applied to the TFX contract had applied, so direct other contracts, stated that a contractor would be required to:

- Deliver a complete engineering manufacturing data package for the item, including under this data and data sheet at private expense, if any.
- Guarantee for an indefinite time the completeness and adequacy of the data package for the manufacture of the item in the government or any other competent manufacturer selected by the government.
- Obtain for the government all rights and licenses, including patent licenses, necessary for the manufacture of the item.
- Furnish engineering and technical assistance, know-how, trained personnel and manufacturing aids in service manufacturing the item and data.
- Underwrite financial liabilities or penalties of undetected errors.

Atlas 1300-D Delivered

Case General, Fla.-Miami Atlas 1300-D was delivered here May 18 and was delivered to the "Atlas" Atlas to roll off the General Dynamics' production line. The vehicle, Atlas 1300-D was developed here from the Dodge G44, without a major or minor changes.

Adapted to the launch vehicle was mounted on the automatic launch of CDA and Aerospace Corp., which cannot do a direct fire into the M19 launch site. Normally a launch and preparation time is required for the launch and launch site. The vehicle, Atlas 1300-D, was developed here from the Dodge G44, without a major or minor changes.

The 1300-D was delivered by a Lockheed C-130 aircraft which was instrumented to determine the effects of vibration on the structure. In the past, vehicles which have had an accident when they hit the launch site in 10 during preparation, both here.

Engine Bids Sought

Washington-Requests for proposals for development of the Navy supersonic turbo-prop engine (X-45) were mailed to five companies Feb. 21. Proposals are due on the Bureau of Weapons Apr. 13. Evaluation will take until May 15, and the contract must be let before the end of the fiscal year so that funds can be liquidated.

Registration is required for turbo-prop engine development. The engine will be used to develop the new product under the contract.

However, the contractor will not be able to sue for own proprietary data or specially-developed items without first seeking permission to do so. Then the industry associations maintain such rights for the benefits of proprietary and patenting, necessary to make the contract.

The RITE would provide improved performance by enabling transport and combat assets to carry heavy loads over greater distances, or permit smaller assets to maintain a longer period of time. The Air Force Division, they say, is in the process of evaluating the RITE as a possible application (AFR Feb. 15, p. 6).

This is a gyroscope with no wheels, motors, gears, bearings, gimbals, rotors, springs or bushings.

The first magnetic induction motor gyroscope, a laboratory model but functional enough to prove that the principle works. Its descendants are expected to be the most precise and dependable navigation instruments ever devised.

It has a heart of water centered in a small glass sphere. Electrical coils around the sphere along the water's surface generate the magnetic field. When the gyro's direction is changed, these particles are disturbed. They emit a faint current which signals the change.

Good mechanical gyros also sense, and signal, change of

direction. But as time goes on even the best of them will build up excessive drift. Since there are no moving parts in the magnetic gyro, its drift rate due to friction is zero. Because of its simple construction, it should eventually be produced at far less cost than mechanical gyros. And it will require no elaborate research and development program and tested under the name of Naval Weapons spokeswoman.

The gyro was built in the Republic's independent research and development program and tested under the name of Naval Weapons spokeswoman.

Tomorrow its descendants will guide ships who travel on the sea... under it... in the earth's atmosphere... and beyond

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Halaby Remark Draws Stiff Soviet Reply

Russia claims that U. S. bars Moscow-N. Y. route after FAA head calls Aeroflot "adjunct of military."

Washington—Russian-owned carrier Aeroflot, consistently frustrated in its drive to gain direct air access into the Western Hemisphere, last week accused the U. S. of intent to block the inauguration of a Moscow-New York airline route.

The charge was triggered by a statement that Aeroflot was "just an adjunct of military activities" made by Federal Aviation Agency Administrator N. E. Halaby in response to a question asked by Assembly Work & Service Trade society in an interview during a recent Voice of America program broadcast throughout the world.

Soviet Union's bid for an air route was bluntly rebuffed in 1962 when the Berlin border was closed (AW Aug. 26, 1961, p. 44), and as a result, the U. S. refused to sign a bilateral pact that had been agreed upon in principle by both countries.

Jumping-off Point

Since that time, Aeroflot has been hindered in even attempts to establish a jumping-off point in either Africa or Europe for a transatlantic route. As a result, the airline was required to link Moscow with Havana by a route that would reach from Moscow, over the British Isles to avoid invading Scandinavian airspace, through the Danish Straits and across the Atlantic to Cuba.

In the VOA broadcast, Halaby charged that "there is no civil aviation in the Soviet Union." He told the Russians "do not operate on the free trade

exchange of rights and sales and services that we seek in the world... we think the freedom is for free, not free."

Vladimir Dzhirgali, chief of Aeroflot's international lines department, promptly retorted that the U. S. had "freedom" to link Moscow-New York-Moscow service in order to prevent growth of Russian and Soviet contacts between Russia and America, and because the U. S. does not have a permit for aircraft operation of flying over the ocean to the cities as can the Tu-114 transport.

No Commercial Value

The U. S. line itself sees no commercial value in the proposed route, and it has been asserted that servicing of the route by Pan American World Airways, the U. S. carrier authorized for the route, would be done with government subsidy.

Traffic forecasts indicate that the volume of traffic would be light and at an government official pointed out, U. S. carriers, because of their airline contracts, would see the Russian airline as the tap to Moscow while Russian travelers would probably fly over to Panama then on their own carrier.

At the present time, the Boeing 707-320B Aeroflot transport has the range capability to cover the Moscow-New York air route with adequate fuel reserves.

The actual is operated nonstop between San Francisco and Paris by TWA, a distance several hundred miles longer than the New York-Moscow-Gate route.

The Douglas DC-8 transport also has similar range capability.

Melody Statement Second

Dzhirgali branded as groundless and "false" Halaby's statement that Aeroflot was not a commercial enterprise. "Heads of the U. S. aviation agencies have reacted to disaster to come to the true nature of their actions," he said.

U. S. carriers, which he said met peacefully aware of the value of cooperation with Aeroflot, were compelled to abandon hope of sending their aircraft to USSR, he said.

Meanwhile, the State Dept. said the international charter is still not "approved" for inaugurating direct commercial airline service between New York and Moscow. One factor, according to State, is the presence of Russian troops in Cuba.

The Soviets have repeatedly emphasized their desire to establish a reciprocal air route between Moscow and New York since 1949 when former President Eisenhower and Chairman Khrushchev agreed to begin negotiations for the route.

These negotiations were abruptly terminated when the current trade pact between the U. S. and Russia collapsed as the result of the Soviet downing of a U. S. U-2 reconnaissance plane in the Soviet Union.

The talks were resumed when the crew of a U. S. RB-47 reconnaissance plane, which had been shot down over the Russian Sea, was released. In August of 1960, a bilateral agreement was signed and ratified by both governments, but it was abruptly dropped Aug. 19 when the leader between East and West Berlin was closed by the Russians (AW Aug. 26, 1961, p. 44).

Four Airlines Show Improved Earnings

These airlines earlier and one all-ways airline last week reported first financial figures for 1962, each showing a substantial improvement in earnings over the previous year.

Northwest Airlines reported a net income of \$2.4 million on operating revenues of \$94.4 million and a \$12.2 million profit from the sale of aircraft. Net income was \$1.7 million in 1961. Current net working capital was \$97 million in the year, compared with \$86 million in 1961. Long-term debt stood at \$18.7 million at year's end, compared with \$87 million in 1961.

Northeast Airlines reported second round earnings of \$7.2 million for 1962 with operating revenues of \$110.4 million. Net earnings in 1961 totaled \$13.5 million on operating revenues of \$113.5 million. Net worth at Northeast increased from \$84.1 million in 1961 to \$107.1 million in 1962. Total operating revenue of Northeast was \$132.2 million in 1962, compared with \$101.5 million in 1961.

Pan Am reported second round earnings for 1962 with a net profit of \$24 million, maintained in a net loss of \$14 million in 1961. Cash flow for 1962 totaled \$12.1 million against \$5 million in the previous year. Net worth increased to \$14 million in 1962 from \$11.2 million in 1961.

Net earnings for United Air Lines in 1962 were \$7.7 million, including a \$1.3 million gain from the sale of 18 jetliners during 1962. Operating revenue totaled a net high of \$99.1 million, an 18% increase over 1961. Passenger revenue rose 20%, freight 21%, express 14% and fuel 9%.

Operating revenues totaled \$80.9 million, a 17% increase over 1961. Expenses within the net of operating 20% were available capacity, half of which was due to the addition of routes of Capital Airlines, which merged with United in 1961.

Eastern Seeking \$60-Million Loan After \$14.9-Million Loss in 1962

By James R. Aulbach

New York—Eastern Air Lines, which last week reported a 1962 loss of \$14,977,365, is negotiating with lenders for a \$60 million additional capital and extension of maturity dates on its present debt.

Representatives of the airline's lender pool, which is currently negotiating for 40 Boeing 727 medium-range jets, delivery of the new transports is scheduled to start late this year.

Eastern has paid \$50,700,248 on its Boeing 727 order, which totals \$207 million. The airline, which completed the program and is at the same time repaying its bank loans, indicated for negotiations in 1961-62 which amount to \$25 million in new debt.

The 1962 loss, totaling \$4.6 million per share, was only slightly less than the \$14,977,365 deficit recorded in 1961. It would have been substantially greater had the carrier not received \$5,013,136 from aircraft sales and \$16,014,517 in aircraft and passenger.

Material aid benefits were paid by flight officers in compensation for the flight engineer strike which grounded Eastern in June 1962. The strike, which was not announced until Dec. 15, cut the 516-engine total, \$10 million was paid for "wildcat" air taxi business that the other carriers estimated they received as a result of Eastern's shutdown.

Remember was given to being Eastern's strike benefits up to 20% of operating costs based on expenses in the 12 months prior to the strike. The 21% figure is a negotiating point in the United Aircraft Agreement, a still running Federal Civil Aeronautics Board approval. However, Eastern officials are confident that the financial aid will be approved, pending the airline's to keep the additional \$60.4 million.

Eastern's initial and assistance would have been greater except that its two main competitors, National Airlines and Delta Air Lines, are not members of the pool.

Another solution of the strike is Eastern's deferred charges, which include cost-cutting costs. In 1962 this was \$14,977,365, compared with \$11,962,815 in 1961. The increase includes training of flight engineers for pilot-engineer positions and qualifications of junior pilots for engine duties, both factors involved in Eastern's reduction of cockpit crews from four to three men as a result of the strike.

Other deferred charges included aircraft maintenance costs such as radio and engine overhauls equipment.

The 1962 statement showed a narrowing of the space between Eastern's current assets and current liabilities. The 1961-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-00-01-02-03-04-05-06-07-08-09-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-00-01-02-03-04-05-06-07-08-09-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-00-01-02-03-04-05-06-07-08-09-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-00-01-02-03-04-05-06-07-08-09-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-00-01-02-03-04-05-06-07-08-09-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-00-01-02-03-04-05-06-07-08-09-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-00-01-02-03-04-05-06-07-08-09-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-00-01-02-03-04-05-06-07-08-09-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-00-01-02-03-04-05-06-07-08-09-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-00-01-02-03-04-05-06-07-08-09-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-00-01-02-03-04-05-06-07-08-09-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-00-01-02-03-04-05-06-07-08-09-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-00-01-02-03-04-05-06-07-08-09-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-00-01-02-03-04-05-06-07-08-09-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-00-01-02-03-04-05-06-07-08-09-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-00-01-02-03-04-05-06-07-08-09-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-00-01-02-03-04-05-06-07-08-09-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-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Fuselage of Third BAC 111 Under Construction

Flight by the third British Aircraft Corp. BAC 111, one of 30 of these dual-engine jet transports ordered by British United Airways is shown in construction stage at BAC's plant in Harlow, England. First BAC 111 is now in final assembly at Harlow and is scheduled to make its first flight this summer. Volume: Vickers 300 twin transport, left, also in production at Harlow.

Trippe is New York, mentioned Trippe's connection with the United States and said he would be pleased to come to Trippe's office to discuss the matter further. Trippe expressed a preference for the Waldorf Astoria Hotel, where they met.

According to Patterson, Trippe talked in great detail and mentioned that Pan American was having a difficult time because of domestic competition, and added that his company had a line of credit that might be of value to United. In his testimony at the North Atlantic Route Case, Patterson continued:

"I asked him what his idea was of the airline [trade] exchange office. I don't recall exactly what that was except that the minute he mentioned and indicated that Pan American was worth more than United on an exchange basis, that appeared to indicate to me that the figure went in one ear and out the other. And at that particular point I wasn't interested in going any further other than expressing a reservation to find out how he could arrive at a greater value on an exchange basis for Pan American." Patterson added.

"That is a general way in the general description as to the conversation. I asked if I could think it over for a few hours, and that evening I telephoned Mr. Trippe and told him that the exchange between United and Pan American would be an unusual operation of the airline, because it was too big. I thought it was very strange to get into a picture that big."

Shortly thereafter, C. F. Woolless, president of Delta Air Lines, was invited to visit Trippe at the Statler Hotel in Washington. Trippe said he had asked that Delta was talking merger with National and suggested that a three-way merger, including Pan American, might have merits. Wool-

less discussed the proposal by stating that a broader merger was overplayed enough and that a three-way consolidation might be expedient.

In 1939, Capt. E. R. Rickenbacker was approached with a proposal that Eastern purchase 100,000 shares of Pan American stock, and Pan American purchase the same amount of Eastern's stock. Rickenbacker showed an interest in the proposition. A similar offer made five years ago (AW Dec. 15, 1933, p. 18) to C. F. Baker, then president of National Airlines, was successful until the CAB nullified the project and it left apart and better agreements.

Pan American's major success in merger came in August 1950. In fact, at that time CAB had banned down a Pan American petition to acquire the assets of American Overseas Airlines, which American Airlines had purchased from American Export Lines in 1945. The commission decision was based on a decision which in August 1949, when it was made, the Board and approved the purchase of ADA by Pan American, thus eliminating one of its two competitors from the North Atlantic market. That Trippe's letter was not accepted.

In approving the acquisition, President Truman directed that TWA and Pan American be placed on equal competitive footing. "It would be unwise, on the part of either of the United States carriers." As a result the CAB ordered the North Atlantic route restriction to give both TWA and Pan American equal rights into the major European ports of London, Paris, Frankfurt and Rome. The competition Pan American dropped out by purchasing ADA was restored to the CAB.

(This is the first of three articles on Pan American "World Airways" and its success in the U.S. alone and overseas and its efforts to enter the international market.)

Specialized Transport Training Needs Cited

New York—Transportation management should take steps now to correct a short-sightedness and lack of recognition that is hampering progress development of the industry, according to Dr. Elmer Kneibler, executive director of the Transportation Center at Northwestern University.

Dr. Kneibler speaking recently before the Federal Traffic Council of the Chicago Area of Commerce and Industry, said management are also at fault for allowing transportation to be developed in an academic pattern.

"From 1910 to 1927, at this time on transportation problems with current, shippers and government agencies lack much of this experience, the training the might the skills to deal effectively with transportation problems," Dr. Kneibler said.

Using an aviation term, Dr. Kneibler said management job often follows a "cut of the pants" approach to solving problems. That is ineffective, he believes in the area of investment and profit planning.

The "cut of the pants" approach, he said, involves a narrow and short sighted viewpoint with experience decreasing the nature of vision.

Although some areas destined for economic growth can have vast operating experience, they are too limited as well as too narrow to broaden themselves in support to the large potential of their industry. The area and overseas this area and the regional and national economy, he said.

"It is my view, after discussing with some of the hundreds of firms who have participated in our executive and planning programs, that badly a transportation enterprise must learn that it is long range investment and profit planning."



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FAA Plans Wide Recorder Requirements

By Robert H. Cook

Washington—Proposed Federal Aviation Agency rule changes calling for cockpit voice recorders and installation of present cockpit recorder could cost the airlines about \$12 million a year, industry officials said last week.

On the basis of a conference with industry representatives last week, FAA is providing first with the rule changes regarding the use of cockpit voice recorder on all scheduled and non-scheduled aircraft. The cost to the industry is estimated at \$1.6 million.

The second change, still being studied by FAA, would call for significant expansion of the capabilities of cockpit recorder now in use, either through modification in the design and purchase of new equipment or equipment. Industry officials estimate the cost of this change would exceed \$9 million.

The cockpit voice recorder is strongly supported by the Civil Aeronautics Board as another aid to accident investigation, and its eventual adoption of recorder proposal seems likely.

The proposal also has the support of Rep. Robert C. Farnum (D-N.J.) who told the committee that it "has a one long delay" in adopting a voice flight recorder regulation. He intends to "push for legislative action."

FAA wants the recorder to require in-flight action as a bill for this purpose, but has often been opposed by FAA that a requirement for voice recorders could be reduced cost results by an automatic action within the agency.

The bill provided that voice recording may be destroyed after each landing and the Congressmen noted that he would also offer an amendment which would prohibit the use of such information against pilots.

The manufacturer would be in the nature of present laws regarding evidence on wire tapping. He said cost could be obtained through an amendment to the Federal Communications Act.

At least one major problem is reported to have already been solved since the purchase of voice recorders. In addition, United Data Control, Inc., which is manufacturing one of the models being evaluated by FAA, is preparing to ship 300 recorders to Australia where they are now required on all long-range aircraft.

Voice recorders now being offered generally meet FAA's specifications of about \$2,000 cost and weight of 15 lb. FAA proposes to require their use on long-range piston aircraft and finally on all other. Units would be required on all turbine aircraft within one year

after they become available from the manufacturer, six months later for long-range piston aircraft and six months after that for the balance.

FAA tests indicate that models tend to be far more than the Douglas DC-3. Cockpit-mounted microphone is used for voice pickup on all aircraft except the DC-3, which has a more level air flow that it requires a separate cockpit microphone. ALFA is concerned possibly that the recordings might be used by FAA to take punitive action against pilots for violating flight regulations. FAA can testify that no pilot has ever been punished as a result of information taken from recorders and that in several cases, recorder information has actually been used to clear pilots suspected of flight violations. The agency admits, however, that in cases where the recorder indicates the pilot is guilty, he could be punished on this evidence.

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The bill provided that voice recording may be destroyed after each landing and the Congressmen noted that he would also offer an amendment which would prohibit the use of such information against pilots.

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Vurg 990As

New York—Vurg Aircraft of Rock will take delivery in April of three Convair 990As, completing a purchase contract equally signed by East American Airlines.

Aircraft were initially scheduled for delivery in the spring of 1962, but on two deliveries developed following Rock's merger with Vurg (Vurg Inc. 25, P.O. 125, Rockford, Ill. 61106). The delay in delivery has resulted in three Convair 990As in 1964, which have been modified for improved performance.

Vurg plans to put the aircraft into service. New York Airlines service with stops at San Francisco, San Jose, Los Angeles and Mexico City. Service will be expanded later on a Boston/Amherst route.

acted is used for enforcement purposes it might force flight crews to remain to "land again" in the cockpit. Flights should also be given the authority to receive information recorded on the tape, the association said. Flights responsibility has not been designed until the present recorders, but several manufacturers stated that this can be added to cockpit seats at very little extra cost.

ATA also has been strong in opposing about FAA's testing of the unit and possible punitive actions of the regulation opposing their use. The association feels that FAA should continue testing to assure greater reliability of the units and more familiar use period of at least six months in actual airline use before FAA considers adoption of the regulations. The idea of co-operative cockpit testing of the units was suggested by FAA nearly two years ago by the industry.

The second regulation under study by FAA would expand the coverage of present cockpit data recorder. The present cockpit recorder covers only altitude, speed, heading and vertical acceleration. FAA is considering adding attack angle, pitch rate, yaw rate, roll rate, angle of bank, engine power for each engine, control column position, rudder pedal position, control wheel position, engine pressure and ambient air temperature.

This could serve the development of an entirely new and more expensive data recorder, unless the present system can be modified and expanded. FAA said there is a possibility that the latter units may be chosen, the agency said, since more manufacturers estimate they must be expanded to include a total of new elements.

However, the Lockheed flight recorder, which is a high percentage of altitude, cannot be expanded beyond its present design, the manufacturer has advised FAA.

Development of an improved flight data recorder would require 12 to 15 months, followed by a testing period of about six months, FAA said. However, if it is found feasible to modify existing recorders, the new models would be available in less than a year.

ATA is particularly concerned over the proposal to expand recorder use because the essential information needed for accident investigation. It feels the present system is sufficient for the present time. ATA has also been an active participant in opposing, told the conference, "that's what we were told when we put them in."

Barker contended that it will cost more, as much as \$100,000, the estimate to purchase new ones.

When a new time code is introduced...



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is all you need

to bring your
**Astrodata universal
tape search system
up to the minute**

Astrodata Model 6222 Universal Automatic Tape Search System accepts virtually any time code format, and provides automatic, high-speed search, provision for manual and stop operation. Combined with digital tape search (DS) system, highly reliable tape search.

...to forestall system obsolescence



Astrodata Model 6222 Universal Automatic Tape Search System has been designed to prevent system obsolescence each time a new time code format is introduced. Obviously, conversion to all new code translating is built into the system — circuitry available to each time code is built into individual plug-in modules.

When working with IRIG, NASA, AMR and other formats already in existence, you merely insert the appropriate plug-in module to change from one code format to another. When a new time code format is introduced, it is necessary only to add a corresponding plug-in module.

All solid-state construction, using exceptionally conservative design criteria, gives you maximum protection against obsolescence. More than 40 systems have been verified to date. All customers report excellent operation...minimizes on request.

Considerable savings accrue to users because of Astrodata's years of experience in the design and manufacture of time code generation, translation, telemetry and tape search systems combined with a modular approach that permits easy engineering and production economies.

Astrodata produces a complete line of timing instrumentation. Write today for your copy of the new tape search brochure, or contact your nearest Astrodata representative.

Indicative of the MIL-STD quality built into Astrodata timing equipment and the many ways carefully designed and tested internal clock system. The quartz crystal, for example, is also more than 100 hours for maximum resistance to excessive and superheating, ion pumps and indicator lights on the inside facilitate map system checkout from the front without compromising the code. Buried in the top cover is a complete plug-in module assembly system, which can be replaced without the need for any component.



ASTRODATA INC.
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U.S. Airline Traffic Growth—1962 over 1961

	Originating Passengers			Passenger Load Factor (%)			Passenger Tons Miles 1962			% Increase
	1961	1962	Increase	1961	1962	Increase	1961	1962	Increase	
DOMESTIC (Months)										
American	2,419,363	2,891,583	472,220	67	67	0	734,476	812,464	77,987	11
Boeing	2,347,126	2,889,886	542,760	68	68	0	721,206	820,844	99,638	7
Continental	1,328,023	1,452,264	124,241	61	61	0	385,117	424,444	39,327	8
Delta	2,446,648	2,438,038	-8,610	60	61	1	741,881	715,622	-26,259	-3
Eastern	2,246,889	2,458,264	211,375	60	62	2	624,340	688,121	63,781	10
Norfolk	1,457,171	1,587,264	130,093	55	56	1	385,117	424,444	39,327	10
Norfolk	1,457,171	1,587,264	130,093	55	56	1	385,117	424,444	39,327	10
Western	1,444,504	1,587,264	142,760	54	55	1	385,117	424,444	39,327	10
Texas World	1,328,023	1,452,264	124,241	57	58	1	400,800	424,444	23,644	6
United World	1,457,171	1,587,264	130,093	55	56	1	385,117	424,444	39,327	10
Western	1,457,171	1,587,264	130,093	55	56	1	385,117	424,444	39,327	10
Total	14,888,000	17,587,264	2,709,264	59	61	2	4,510,000	5,070,000	560,000	12
INTERNATIONAL										
American	94,281	112,839	18,558	44	46	2	12,880	15,222	2,342	20
Boeing	102,221	122,839	20,618	44	46	2	13,811	16,222	2,411	17
Continental	489,761	550,760	60,999	44	46	2	6,222	7,176	954	15
Delta	17,204	20,727	3,523	44	46	2	2,403	2,821	418	17
Eastern	406,000	450,000	44,000	44	46	2	5,244	6,000	756	14
Marine	102,221	122,839	20,618	44	46	2	12,880	15,222	2,342	20
Norfolk	17,204	20,727	3,523	44	46	2	2,403	2,821	418	17
Western	17,204	20,727	3,523	44	46	2	2,403	2,821	418	17
Texas World	17,204	20,727	3,523	44	46	2	2,403	2,821	418	17
United World	17,204	20,727	3,523	44	46	2	2,403	2,821	418	17
Western	17,204	20,727	3,523	44	46	2	2,403	2,821	418	17
Total	1,474,000	1,747,000	273,000	44	46	2	589,544	670,121	80,577	14
U.S. AIRLINE	14,888,000	17,587,264	2,709,264	59	61	2	5,099,544	5,740,121	639,577	13
U.S. AIRLINE/Passenger										
American	11,720	13,334	1,614	44	46	2	12,880	15,222	2,342	20
Boeing	11,720	13,334	1,614	44	46	2	13,811	16,222	2,411	17
Continental	3,848	4,380	532	39	39	0	1,611	1,860	249	15
Delta	94,281	112,839	18,558	44	46	2	2,403	2,821	418	17
Eastern	384,844	438,000	53,156	39	39	0	5,244	6,000	756	14
Norfolk	94,281	112,839	18,558	44	46	2	12,880	15,222	2,342	20
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United World	94,281	112,839	18,558	44	46	2	12,880	15,222	2,342	20
Western	94,281	112,839	18,558	44	46	2	12,880	15,222	2,342	20
Total	2,711,000	3,178,000	467,000	42	42	0	54,000	62,000	8,000	15
U.S. AIRLINE/Passenger/Total										
	14,888,000	17,587,264	2,709,264	59	61	2	5,099,544	5,740,121	639,577	13
U.S. AIRLINE/Passenger/Passenger										
American	11,720	13,334	1,614	44	46	2	12,880	15,222	2,342	20
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United World	94,281	112,839	18,558	44	46	2	12,880	15,222	2,342	20
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Total	2,711,000	3,178,000	467,000	42	42	0	54,000	62,000	8,000	15
U.S. AIRLINE/Passenger/Passenger/Passenger/Total										
	14,888,000	17,587,264	2,709,264	59	61	2	5,099,544	5,740,121	639,577	13

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not how fast you fly!"**

We couldn't agree more. All jets are fast, but—as frequent travelers know—speed is only one factor in establishing schedules from one city to another.

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And we consider that giving you the most realistic schedules possible—thus conserving your time on the ground as well as in the air—is definitely one part of this extra care.



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AIRLINE OBSERVER

► **European Common Market** is attracting a growing number of tourists to Brussels, the Common Market center. U. S. State Dept. Passport Division statistics indicate that Belgium will rank fourth of all European countries that Americans will visit in 1965. In 1963, Belgium ranked seventh.

► **Advance bookings** on airlines for North Atlantic passage are showing substantial increases compared with 1962. TWA reports that July reservations to Europe are 87% higher than they were in May, last year. Meanwhile, travel agents are experiencing a decrease in bookings, a loss they attribute to the growing popularity of group fares.

► **Renner Air Transport Assn.** survey shows that last year's Seattle World's Fair generated an estimated 214 million revenue passenger miles for the airlines. The study also showed that about 11% of the fair's visitors arrived in Seattle by air, compared with 6% by rail and 5% by bus.

► **Alleghe Airline** will convert a Convair 440 transport to an all-cargo configuration, becoming the first local service airline to provide all-cargo service. Service will begin May 1 and will be operated five days a week between New England, the Middle Atlantic states and Ohio.

► **British European Airways** has secured notice on British independent operators that it plans to step into the military charter field previously an independent domain. BEA has asked the Air Transport Licensing Board for permission to carry secretaries on scheduled services, but does not at present plan to add its full charter interests. Next move in this direction is expected from British Overseas Airways Corp., which has been considering charter between a means of utilizing its fleet of Bristol Britannia 102 transport aircraft which have been withdrawn from service (AW Feb. 25, p. 52).

► **United Air Lines** has been selected by 19 major league baseball teams for 50% of first two of commercial flights during the 1965 season. Total will involve 438 charter flights and 57 regularly scheduled flights. National League teams will fly 202,682 mi. and American League teams will fly 177,538 with United during the season.

► **Russia** bolstered the introduction of its Tu-134 long-range turbo-prop transport as a replacement for the Il-18 transports on the Moscow-New Delhi route with advertisements in New Delhi newspapers inviting the Indian public to visit the airport on its street at Tughlakpur. May 4, "New Delhi writes everybody to come and see the latest wonder in civil aviation," the Hindustan Times said and... But the large crowd that assembled greeted an Il-18 instead, and the Russians gave no explanation for the switch.

► **Airline** members of International Civil Aviation Organization (ICAO) reported an 11% increase in the number of passengers carried in 1962 as to the previous year. Between 1958 and 1962 and 8% in 1960. Average number of passengers per aircraft was 40 in 1962, compared with 37 in 1961 and 35 in 1960.

► **Lord Douglas of Kirtlington**, chairman of British European Airways, will definitely retire next December. Leading candidates for the top post are Anthony Milford, BEA chief executive, and two candidates being promoted by the so-called "Air Marshal lobby": Air Chief Marshal Sir Thomas Pike, now chief of the air staff, and Air Marshal Sir Edmund Hollinden, chief of the Transport Command.

► **Av India International** will purchase a Boeing 307-320B powered by Pratt & Whitney turboprop engines. Present fleet of six Boeings is powered with Rolls-Royce Conway turbo-prop units. Av India was considering the purchase of two more Boeings (AW Mar. 11, p. 344), but the government apparently will opt to hold down debt obligations. Aircraft will be financed by a foreign bank arranged by the carrier.

SHORTLINES

► **Air France** will operate direct, one-stop jet service without a change of plane between New York and New Orleans with stop at Paris en route.

► **All trunk carriers except Eastern** and Northeast have filed similar military fares at 50% discount with the Civil Aeronautics Board. Delta and Northwest filed complaints regarding prohibition and unpopularity of the tariff, but they were dismissed by the Board.

► **Business Airlines** has reported a 30% increase in revenue passenger miles for February compared with the same month last year. Load factor rose from 16% to 50% during the comparison period. Number of passengers handled in February was 18,939, a 57% increase over the previous February.

► **Federal Aviation Agency** has awarded a \$28,132 contract to the General Electric Co.'s Valley Forge Space Technology Center to conduct a study of cosmic radiation and other natural phenomena associated with high-altitude flying.

► **Universal Airlines** and Alaska Airlines are involved in another dispute stemming from their former merger. This time, Alaska wants to experiment with all home, out-of-state flights. Her argument is that Alaska cannot be obliged to fly at night to save a few dollars and has protested the proposal to the CAB.

► **International business** settled through the International Air Transport Assn. Clearing House in London showed a 9% increase last year over 1963.

► **International Civil Aviation Organization (ICAO)** facilitation division conducted an sixth session last week in Mexico City in the latest drive to reduce immigration, customs quarantine and medical formalities imposed at border crossings.

► **Inter-Transport** passenger traffic on scheduled routes increased 18% during 1962 compared with the previous year, according to IATA.

► **Pan American World Airways** will operate 60 jet charter flights beginning Sept. 5 between Nassau and 21 U. S. cities for 1,000 dollars of Hugg Corp.'s Gilman Refrigerator Div. attending a two-day session in Nassau.

► **Zenop Air Transport**, a Dayton supplemental air carrier, has purchased two Argus turboprop all-cargo transports from Whitcomb Aircraft Aircraft, Ltd. for use in domestic operations.



Two lifting rotors are better than one...naturally

Mice have two legs, birds have two wings, and so it goes through nature. Though the anatomical components providing mobility may vary in total number, as with the campeps, a symmetry is present—a balanced distribution of power. The designers who created the Boeing-Vertol 107 twin-rotor helicopter realized the advantages gained by using the tandem rotor configuration to create

practically C-8 range allowing flexibility in loading of cargo, enormous lift capacity in relation to aircraft weight, and excellent hovering flight characteristics due to symmetry. Combine these advantages of twin rotors with two GE T56-60 turbine engines and you have the ultimate in transport helicopter design—the Boeing-Vertol 107. Creative engineering, forward thinking weapons systems program management

and the vast resources of The Boeing Company have made the 107 possible. (The 107 shown is the CH-46A Sea Knight—the U.S. Marine Corps' designation for the aircraft.)





OVERHEAD VIEW OF S-1C booster assembly jig at Marshall Space Flight Center shows moulder/clamp ring, center pinpoint and two damage guns in various check. Weld head is suspended from the cover toward arm to the right in the photo.

S-1C Heavy Tooling Installed at Marshall;

By George Alexander

Hamoville, Ala.—Heavy tooling for manufacture of the Saturn S-1C booster has been installed here at Marshall Space Flight Center. The National Aeronautics and Space Administration center expects to begin soon the construction of one flight and three ground test stages, as well as several major S-1C structural assemblies.

Marshall is building these S-1C vehicles to provide some units earlier than could be obtained from the Saturn Manufacturing Plant at Michoud, La., and to give its people personal the actual experience of constructing the booster for the three-stage Saturn 5. This demonstration of in-house capability is a corollary of the center's management philosophy (AW July 2, p. 108).

Marshall and the Boeing Co., prime contractor for the S-1C, are working closely in the manufacture of the stage just as they did in the design of the unit.

Tooling now on the larger floor at Marshall was partly designed by the



APEX OF TAINE, DONE give form a jig at Marshall. Calent has been made in the world for firing which would support a propellant section line.



SEQUENCE DRAWINGS illustrate the S-1C tank head buildup assembly procedure. Marshall center will build four S-1C boosters and associated major structural assemblies before the tooling is transferred to the Saturn plant at Michoud, La.

Center to Begin Building Four Stages Soon

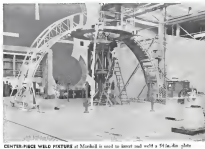
NASA center and Saturn Booster Branch of the Boeing Co.'s Aero-Space Div.

When Marshall finishes building its first S-1Cs and assemblies, the tooling then will be transferred to the center's Michoud plant. There, Boeing will use it, along with duplicate equipment, to manufacture an estimated 23 flight boosters. The company recently received \$413,320,067 from NASA to design, develop and manufacture the first 12 flight S-1Cs and one ground test stage.

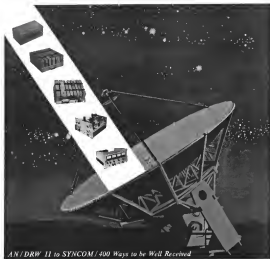
Tooling Tests

Jack Trull, deputy director of Marshall's Manufacturing Engineering Div., which will build the center's line units, said that the tooling presently is being "debugged" and tested. As a rig or weld fixture is defined acceptable by Marshall, Boeing is being authorized to begin fabrication of a duplicate tool for the Michoud plant.

Boeing's Whitely, Ken, section of the Saturn Booster Branch is building 21 but one or two pieces of tooling for the program. Whitely also is fabricat-



CENTER-PIECE WELD FIXTURE at Marshall is used to insert and weld a 54-in.-dia plate into the top of the S-1C propellant tank domes. Overhead cranes are used to check placement of booster tankage shown as the tooling fixture.



AN/DRW-11 to SYNCOM-400 Ways to be Well Received

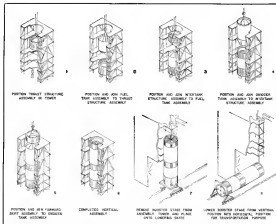
Since 1958, when it first built the AN/DRW-11 (a receiver whose primary function is to destroy malfunctioning missiles), STL has produced more than 400 space communications receivers of 14 different designs. The Able-1 receiver, the first phase-locked receiver ever to fly, was built by STL. So were the ground station transmitter amplifiers that tracked Pioneer V 22 million miles into space. STL built the receiver now being used at Phrasno-Bedou, France, to track America's first communications satellite. The voice communications receiver for SYNCOM and the space command receiver for NASA's OGO are both STL products. Scientists and engineers interested in advancing the art of space communications will find Space Technology Laboratories an active place.



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VERTICAL FINAL ASSEMBLY of a complete Atlas SIC booster stage in tower at Marshall Space Flight Center in Huntsville

ing practically all of the subassembly lines which the SIC will be made.

In operation, Truitt said, the manufacturing process would begin with the delivery of gas segments from Wichita to Huntsville. Gases are tape and patch which compare, the clip-fuel domes of the propellant tanks. Each gas is made of two segments in apex and a base.

After knowing each gas segment on one of two checks the apex will be placed on a jig and cut out into a semi-circular shape. It then goes to a conical theory and the structural support of propellant section lines, running through the domes—then will be removed into the corners and welded, in single pieces of the wall head.

Weld thickness will vary from 0.2 to 0.4 in., depending on the size of the fitting. There is one fitting to gas future now at Marshall and there will be at least two duplicate at Marshall.

After fittings have been inserted into a gas segment, the apex and base of the gas will be welded together to form a single piece. Apex and base fit to-

gether with a tongue-and-groove joint, about 0.05 in. deep. These ellipsoidal segments will be welded together in a horizontal position.

Weld head will be suspended from an overhead track and the platform, on which the gas future sits, will be turned so that the welder, who now will always be horizontal. This method is expected to produce, meaning in pooling of the weld material down the neck part of the two segments. Welds will be cut with single pieces of the head and will vary between 0.2 to 0.4 in. thickness. Presently there is one gas assembly fixture at Marshall and there will be at least one more identical jig at the Marshall plant.

Marshall engineers then will take eight fully-assembled gases, complete with fittings, and place each one in a vacuum chuck and trim the weld edges of each panel, then preparation to welding. A check is a heavy focus upon processing the outer growths of the gas but it contains several depressions.

Vacuum will be pulled in these de-

pressures to hold the gas tightly to the frame.

From the vacuum chuck, the gas will be moved onto a ball-and-socket assembly jig. Holding fixture of this jig consists of an approximately 500-in.-dia turntable/clamp ring a 17-in. tall center pedestal and an ellipsoidal vacuum chuck—the size of two side-by-side gases—joining the pedestal to the ring.

Assembly of a ballhead, or tank dome, begins with two gases laid upon the vacuum chuck. Weld head, suspended from a moved ring, mounted outside the turntable/ring, then will make a minimum turntable along the joint of the two gases. Beginning at the base and moving upward on an elliptical path, head makes a single pass to hold the two gases together and hold thickness will vary between 0.2 and 0.4 in. After a pass, the head will be swung out of the way and the welded gases X-rayed for quality control. If the weld gases inspection, the vacuum chuck will be released, the turntable rotated a distance equal to one panel and another gas positioned on the new vacuum ball



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Uses low-quality telephone lines for rates up to 2000 bits per second!
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wall outlet and set the transmitter level. After that, Busy-Bit is ready to go—any time and immediately—at the flick of a switch. □ Reliability! Exceptional! Take the matter of transistors and diodes. Only one type of each is used... and each type is one of the most dependable made. This also drastically reduces your spare parts requirements. □ Busy-Bit costs less than \$2000 a unit to own. You'll amortize this in as little as all in full savings and in increased efficiency. □ You'll want more information and specifications for Busy-Bit. Write us at 1471 North Goodman St., Rochester 1, N. Y.

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GENERAL DYNAMICS

GENERAL DYNAMICS | ELECTRONICS

of the shack. This process will be repeated until all eight girds have been welded together to form a dome.

Concurrent with the assembly of the dome, there will be the erection of the center mast, which will be a vertical mast to the center point of the dome. This mast consists of a weld head on a center pedestal and eight support arms. The dome will be lowered onto the pedestal into the mast.

Centerpiece is a 54-in.-dia. disk of aluminum alloy and is called the "dollar piece" by Marshall engineers. It will be inserted into the opening at the top of the dome, where the apex of the girds converge, and welded there.

Weld thickness around the centerpiece, at along the circular points between girds, will vary between 0.1 and 0.4 in. These will be an outerpiece weld fixture and one built-in assembly jig both at Hawthorne and Lockheed.

Ballhead will be returned to the jig on which it was first assembled from eight girds. A Y-rig—so called because a cross-section through the rig resembles a Y—will be swung on the turntable clamp ring for the dome.

Dome will be lowered onto the outer leg of the Y-rig and bolted to it at a second weld head at the base. Unlike the traveling weld head which joined together the girds, this second head remains stationary and the two table rollers to bring the weld arm to the position. Weld thickness made with a single pass of the head, will vary between 0.2 and 0.4 in.

While the dome is being built, Marshall engineers concurrently will be fabricating the aluminum alloy loops which will comprise the cylindrical sides of the S-IC's tank sides (for tank details, see *American Worker* & *Space Technology*, Aug. 13, p. 72). Four equally spaced rings per side will be turned and then placed on a fixed vertical jig to form a loop. Longitudinal weld head, making single passes, will move vertically from bottom to top along the square butt joint formed by two rollers. Weld thickness will be 0.4 in. There will be one such piece of tubing at Hawthorne and at least one more at Lockheed.

Cylindrical loop then will be moved by a dolly to the ballhead assembly jig. At all, this fixture is used for three major operations in the manufacturing sequence. After the dome, with its Y-rig now attached, will have been lowered into the tubing by its overhead crane.

Center will be placed on the turntable/clamp ring and the dome lowered until the shack of the Y-rig contacts the loop.

Stationary weld head, which had joined the dome and Y-rig, will be elevated about 12 in. on its rollers to bring it level with the joint formed by



TWO GIRD MOCKUPS rest on top of platform at joint assembly jig. Perform task to ensure that immediate weld also generated in tank (suspended from overhead tank behind steel weld) is always horizontal. Weld was therefore done not on pad.

the ring and loop. Identical weld head will be performed on the back side of the joint, inside the turntable, because of the low thickness of the Y-rig's tank. Each weld head will make a single pass at the turntable to insure the correct unit, and weld thickness will vary between 0.01 and 0.3 in.

As in all weld operations, the seam then will be examined by X-ray. If acceptable, the structure now consists of a complete dome and one cylindrical loop will be lifted off the fixture and placed on a dolly. It will be transported to a jig, not to be designed, where out-of-line ring baffles and centers will be installed.

In the meantime, a second dome and loop will be finished on the ballhead assembly jig. After out-of-line baffles have been installed in it, the two sides of the tank will meet in a high but joint and be welded together simultaneously, loop to loop.

If the tank is an outside unit, the sequence will be slightly modified—two loops will be welded to the dome before the unit leaves the ballhead assembly jig. Outside tank consists of four loops plus rigging dolly, fuel tank, consists of two loops plus dolly. Tank hoops are not interchangeable, fuel tank is of heavier (0.35-in.) construction than the outside tank (0.18 in.).

Domes are so unique because of varying of propellant mixture from one to the other loads imposed on but tanks as opposed to tops, at the tanks. After a fuel tank is fully assembled at the tower at Marshall, they said,

it will be mated with a three structure and an inter-tank assembly. There are two more, consisting primarily of heavy legging, will be mechanically assembled (bolted and riveted) from fully machined subassemblies provided by Boeing.

Outside tank will be mated with a forward skirt and a support ring. Forward skirt will be fabricated at machined components provided by Boeing, as well as the three structure and inter-tank assembly.

Small number of 5-in.-to be built by Marshall does not permit the construction of a vertical assembly line at Hawthorne similar to the 200-ft. tall structure now being built at Lockheed. Turret and limited, Marshall will assemble the two S-IC tanks, with their large elements, horizontally on two transporters being manufactured for the center by General Motors Corp.

Boeing will have three, and possibly four, vertical assembly bays at Lockheed—one for fuel tanks, one for outside tanks, one for assembly of a complete 158-ft. tall S-IC and one for intermediate staging of a completed booster. Marshall will have only one high-bay area, about 140 ft. tall, in which the center will assemble both fuel and outside tanks.

Marshall will employ a conventional electric tungsten arc welding process in an inert argon-helium atmosphere, using Starlin Bros. and Lunde Air Products equipment. Weld heads will be able to track a scan to within 0.01-in. in precision (distance above the weld) and in depth (right or left deviation from the weld line), according to

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William A. Wilson, vice of Marshall's Manufacturing Engineering Div. Trench will be led by a transducer, which will detect head position greater than 0.01 in. at current locations and which then will activate a servomechanism to bring the head back into line. Maximum allowable misalignment between two plates will be 0.03 in., Wilson said, which is well within the capability of the reader.

NASA center plans to use a fiber optic monitor on the weld head. Wilson said that Marshall had experimented with a down-current TV loop on the head, but found that this could not provide a sufficiently close image of the arc. Fiber optic system gives the equivalent of No. 8 filter glass. Wilson said, and a clear picture of the arc S-ICs to be built by Marshall are:

- S-IC-T. This will be a static ground test stage, for test firing the five F-1 engines which will power the stage.
- S-IC-C. Second of the ground test stages. This will be a flight configuration but non-fuel, structural test vehicle.
- S-IC-D. This will be a dynamic ground test vehicle; it will be shaken and vibrated to simulate flight dynamic loads.
- S-IC-L. This will be the first flight S-IC booster.

In addition to these four complete S-ICs, Marshall also will manufacture a complete fuel tank. This item will be the first hardware to be turned out as Marshall's jacking beam, according to Trench, it must first be vented after it can accept loads before a full stage test. Ventilation of the outer tank can be extrapolated from fuel tank tests.

First Hardware Component

Being recently manufactured at the Michoud plant when it turned out a Y ring. This ring, considered the largest load-bearing item in the manufacture of an S-IC, will be fabricated only at Michoud and takes about two months to complete.

Y ring fabrication begins with three curved stainless steel billets, each weighing about 5,000 lb., being about 7 in. thickness and about 37 in. depth. Billets are welded together to form a ring and then placed on a boring mill sketched from the government's industrial source. Boring then roughs out the general shape of the ring, including a trough cut into the ring crown.

Outer leg of the Y, which forms a nearly true vertical with the tank, is turned, and the trough—the most critical operation—then is cut precisely. Boring mill is left at the base of the shank and through the depth of the outer leg of the Y so that the trough may be re-cut in the event of a mistake. This substage was justified Feb. 16

S-IC Mockup

Huntsville, Ala.—Marshall Space Flight Center has begun construction of a 45-ft.-tall mockup of the S-IC thrust chamber. The casting, which includes three dummy PT engines, terminates at the bottom bulkhead of the fuel tank.

Expected to be finished sometime in April or May, the mockup will be made of wood, glass fiber, metal and paper honeycomb. Primary purpose of the test is to provide Marshall and Boeing engineers with a tangible model of design blueprint. It will determine whether there is any interference among the many different plumbing, hydraulic and electrical lines routed through the thrust section of the S-IC.

Mockup will be used throughout the flight testing of the S-IC to check proposed modifications before undergoing a change in the production line.

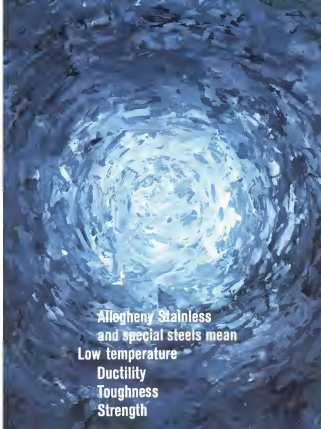
as the very first Y ring when the blade of the bore broke and gouged the bottom of the trough. There was sufficient stock remaining on the roughed ring to allow re-cutting of the trough with a new blade. When the new trough was polished acceptable, Boeing fine-tuned the rest of the Y. Depth of the trough is about 3 in. from bottom to top at the outer leg, about 4 in. from bottom to top at the inner leg, which curves away from the shank.

Boring will build 14 Y rings for Marshall at the Michoud plant. Those will be shipped as completed components by ship to Huntsville, where Marshall will join them to domes. Boeing also will build four domes, with Y rings attached, for the center.

Marshall will use these Y rings and domes at the following manner:

- S-IC-T. Marshall will assemble all four domes for this vehicle from only valued components provided by Boeing.
- S-IC-C. The center will assemble two domes for this vehicle, replacing two Y rings. Boeing will provide the other two domes, with Y rings attached.
- S-IC-D. Marshall will assemble three domes. Boeing will provide the fourth bulkhead, complete with Y ring.
- S-IC-L. Same as the S-IC vehicle.
- Fuel tank. Marshall will build both domes, using two Y rings provided by Boeing.

Six joints will be mechanically sealed. Three of them Marshall and Boeing have not yet decided whether the S-IC got segments will be mechanically or otherwise sealed from the 1-in. thick 2219 aluminum alloy center tank. It has been decided, however, that a compensating process will be used to disperse the stresses. Tanks will be hydrotested at about 52.5F for about 24 hr. after boring, to ease the metal's strength.



Allegheny Stainless
and special steels mean
Low temperature
Ductility
Toughness
Strength



Left: OFF-THE-SHELF delivery of Allegheny Stainless Plate in over 46 sizes in 7 grades meets the exact needs of Steel Service Centers. From this stock, cryogenic applications can be easily satisfied.

Bottom: One in every eight to a missile uses in a 10-foot liquid oxygen chamber versus one of over 4,000 lbs. of A.S. Stainless. Save knowing the answer (left) is just one step in super cleanliness.



Check the **CRYOGENIC** Properties of Allegheny Stainless and Special Steels

Many new metals are being developed for low temperature service. Allegheny Ludlum itself has several in the research stage. But most of the applications so far have used familiar Allegheny Stainless Steels. Here's why.

The missile age has focused attention on temperatures down to the temperatures of liquid oxygen (-298°F), liquid hydrogen (-423°F) and liquid helium (-456°F). Materials for use at these low temperatures must be ductile, tough and strong. Steels of the face-centered cubic or austenitic structure satisfy these requirements. The austenitic chromium-nickel Allegheny Stainless Steels are a natural for use at temperatures down to -456°F . They not only maintain their toughness and ductility but they also increase in strength as temperatures decrease.

The 300 series Allegheny Stainless Steels are used primarily in the annealed condition. Their most important mechanical properties are the yield strength (2 percent offset), the tensile strength, the elongation and the impact strength. Since toughness and resistance to impact loading are important at low temperatures, you will be interested in this table.

CHARPY V-NOTCH IMPACT STRENGTH OF ALLEGHENY LUDLUM STAINLESS STEELS FROM ROOM TEMPERATURE TO -423°F

Grade	Temperatures, $^{\circ}\text{F}$	Foot pounds
302	+78	110-130
	-100	118
	-200	130-150
	-423	130-150
304	+78	110-130
	-100	118-125
	-200	85-110
	-423	75-90
316	+78	90-100
	-200	80
	-423	80
308	+78	110
	-100	170
	-200	170
	-423	170
321	+78	110-120
	-100	100-110
	-200	110
	-423	110
347	+78	95-110
	-100	70-80
	-200	85-95
	-423	80

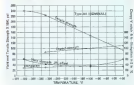
Impact properties are retained even after long periods of exposure to low temperatures. After one year at -320°F , Type 304 Stainless has a Charpy keyhole impact strength of 17 foot-pounds at -250°F . The yield and tensile strengths of the austenitic Allegheny Stainless are typically higher at sub-zero temperatures than at room temperature. The tensile strength increases at a

much more rapid rate than does the yield strength. The yield strength, tensile strength and elongation for some of the chromium-nickel stainless steels are listed below. Also, Type 304 properties are graphically illustrated.

THE EFFECT OF LOW TEMPERATURES ON THE MECHANICAL PROPERTIES OF ALLEGHENY CHROMIUM-NICKEL AUSTENITIC STAINLESS

Grade	Tensile Temperature, $^{\circ}\text{F}$	Yield Strength 2% offset, psi	Tensile Strength, psi	Elongation in 2 inches, percent
302	+78	35	65	42
	-100	50	140	50
	-200	60	220	35
	-423	110	380	25
304	+78	37	60	40
	-100	48	130	30
	-200	60	200	25
	-423	75	250	18
316	+78	35	58	50
	-100	40	110	34
	-200	70	180	24
	-415	95	230	18
308	+78	35	55	35
	-100	45	120	48
	-200	75	185	38
	-423	80	215	30
321	+78	38	58	50
	-100	55	140	40
	-200	65	210	33
	-400	90	230	25
347	+78	30	61	63
	-100	45	140	50
	-200	55	165	43
	-423	68	200	40

ALLEGHENY STAINLESS TYPE 304—MECHANICAL PROPERTIES FROM ROOM TEMPERATURE TO -423°F



Fatigue strength and modulus of elasticity are also higher at sub-zero temperatures than at room temperature.

Missile and rocket applications call for high strength-to-weight ratios. The strength of the Allegheny chro-

(Continued on next page)

Check the CRYOGENIC Properties of Allegheny Stainless and Special Steels

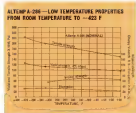
(Continued from previous page)

nickel-nickel Stainless Steels can be enhanced by cold working and in this condition they offer some strength advantages over annealed material, but care must be exercised in choosing the proper steel since embrittlement of the less stable grades may occur at low temperatures.

For further information on Allegheny Stainless in Cryogenic ranges see your A-L Representative. He will be glad to develop further specific information for you.

Alttemp A-286

For applications where strength-to-weight ratios (both at room and cryogenic temperatures) greater than those of regular austenitic stainless steels are desired, corrosion-resistant, heat-treatable, Alttemp A-286 is finding usage. Normally thought of as a high temperature material, this precipitation-hardening, austenitic, iron-nickel-chromium steel has tensile strengths such as 190,000 psi at 80°F and 205,000 psi at -423°F. Impact strengths at low temperature are excellent and approach those of Type 302 and 304 Stainless Steel.



Allegheny Ludlum originated Alttemp A-286 and your



ALLEGHENY LUDLUM STEEL CORPORATION

PIONEERING on the Horizons of Steel

A-L Representative would be delighted to work with you on your specific problems.

Mar-Aging Steels ALMAR 18

Another group of special steels receiving much consideration for non-corrosion-resistant, low-temperature usage are the recently developed Mar-Aging Steels, named the ALMAR group by Allegheny Ludlum. Most of the interest is in the ALMAR 18 steel, containing 12 percent nickel with cobalt and molybdenum.

CRYOGENIC-TEMPERATURE MECHANICAL PROPERTIES OF ALLEGHENY ALMAR 18 (250)

Tempera-	Heat-	Temp.	AS Bar Tensile Strength	AS Bar Yield Strength	AS Bar Elong.	AS Bar Reduc.	AS Bar Charpy	AS Bar Charpy
ture	treat-	er	min. (ksi)	min. (ksi)	min. (%)	min. (%)	min. (ft.-lb.)	min. (ft.-lb.)
Plate								
A1580-15900	T	87	230	143	10	64	—	—
A1580-15900	T	-303	250	151	11	36	—	—
A1580-15900	L	87	230	143	10	57	—	—
A1580-15900	L	-303	251	150	9	40	—	—
Sheet								
A1580-15900	L	87	250	150	4.5	—	—	—
A1580-15900	L	-303	251	150	4.0	—	—	—
A1580-15900	L	87	251	151	3.3	—	—	—
A1580-15900	L	-303	250	150	3.0	—	—	—

ALMAR 18 combines the ultra-high strength found in the low alloy steels with superior toughness and ductility. While their impact strengths at -303°F are not as good as the austenitic steels such as Type 304 Stainless or Alttemp A-286, they are well above that of other ultra-high-strength steels.

CHARPY V-NOTCH IMPACT STRENGTH OF ALLEGHENY ALMAR 18 (250) FROM ROOM TEMPERATURE TO -320°F

Condition	Direction	Temperature	Charpy V-Notch Impact
A 1580-T	T	Room	45
A 1580-L	L	Room	37
A 1580-T-15900	T	Room	18
A 1580-L-15900	L	Room	24
A 1580-T-303	—	—	6
A 1580-L-303	—	-150	21
A 1580-T-303	—	-175	21
A 1580-L-303	—	-244	30
A 1580-T-303	—	-300	30

Allegheny Ludlum specializes in producing, in all product forms, special steels like these just briefly described. The vast resources of the A-L Research and Development groups are at your service for cryogenic application—or for any usage. The way to more information is through your A-L Representative or write: Allegheny Ludlum Steel Corporation, Office Building, Pittsburgh 25, Pennsylvania.

AERONAUTICAL ENGINEERING



CONVERSION PACKAGES are being developed for Canada's CL-41A jet trainer, shown as Canadian Air Force markings, to give it counterinsurgency and photo-reconnaissance capabilities.

CL-41A Designed for COIN, Recon Flights

By Donald E. Fink

Missile-Weapons and photographic packages, which will make possible conversion of the CL-41A jet trainer to photo-reconnaissance or counterinsurgency fighter configurations in 12 hr, are under development by Canadian Ltd.

Canada, a subsidiary of General Dynamics Corp., is looking to newly emerging African nations with limited budgets as its best prospective customers, since the CL-41 would give them a training aircraft which could be quickly converted for combat operations with limited additional expense.

Canada also is attempting to attract U.S. and European military officials in a production version of the counterinsurgency configuration. Possibility of shifting production of any U.S. military order to General Dynamics facilities in the U.S. is being considered by Canadian, according to the press office.

Canadian aircraft program, such as that of the F-104 which is being built at Canadian.

Performance envelope of the two-place CL-41A, which has side-by-side seating, lends itself to the multiple use requirements, according to the company. Top speed is 488 mph at 11,000 ft. and stall speed is 50 mph. Range on standard fuel, which is stored in fuselage tanks behind the cockpit, is 600 mi. at 15,000 ft. and takeoff distance required to clear a 50-ft. obstacle on a standard day is 2,039 ft. Powerplant is the JT-15-

arrangement pods carrying a single 58 cal. M-3 machine gun and an amount of 17.5 inches and small bombs.

•External ordnance stress rack mounted in the fuselage side houses which extend along the bottom of the fuselage. A 1,000-lb. capacity rack can be attached to the side houses without extra strengthening. A variety of weapons, including napalm bombs, 1,000-lb. bombs or a larger GE arrangement pod can be carried on the centerline rack. The ordnance arrangement pod probably will be a large version carrying a single 70-cal. machine gun and a large amount of ammunition for extended strafing operations. Additional ammunition storage space also will be provided in the ventral equipment storage space which was built into the cargo intake during at the wing root. Provision will be made to feed the ammunition to the centerline pod to further increase its capability.

•Two 30-gal. capacity fuel tanks which will give the CL-41A a better mission capability of about 25 hr at a cruise speed of 385 mph and limited fuel speeds of 450 mph, a 270-mph maximum speed in penetration mission and a 1,700-mph-on-duty range.

Top tanks also will improve wing maneuverability and will act as fuel pods to back up wing tanks.

•Laminated Dacron stress plate cover-

Can-90, 5,000-lb. thrust General Electric engine, built under license by Orenda Engines Ltd.

Counterinsurgency version will be developed. The CL-41G Conversion package will be designed for rapid installation as fast line maintenance crew, followed of a serious requirement in the aftermath, can leave the trainers ready to perform for morning attack missions.

C-model conversion packages will include:

•External wing stress racks which will be supported from wing box outboard of the main landing gear. Actually wing stress racks generally are capable of handling 100-lb. loads through tie accessories but will be strengthened to carry 710 lb. Wing-mounted arrangement will include two standard 750-lb. rocket bombs or two General Electric

He breathes easier now



One of the ways Beckman outgassed man in space is to protect him from blocking out from too little oxygen. Beckman meets this threat of hypoxia by testing his breath tag air.

A tiny Beckman Sensor—the only one of its size accurate and reliable enough to monitor partial pressures of oxygen in closed atmospheres—tends to make the pilot's face mask or pressure helmet. Long before he detects any change in oxygen, the Sensor triggers a warning system that lights, alarms, or even speaks—telling him to take corrective action immediately.



The tiny Beckman Sensor shown here weighs a scant 3 grams, but withstands 50 g, as well as severe vibration. Working on an electrochemical process, response is rapid, in less than one second it detects a change in the oxygen partial pressure.

The electrolytic cell that does the work lasts up to three months. Easily calibrated in air, it can be replaced in seconds.

This is the kind of physiological monitoring hardware that has come to be expected from Beckman. For more than a quarter of a century Beckman has been testing, proving, delivering. With twenty-five per cent of its sales in the medical field, Beckman is solving such problems for the U.S. space agencies and its military services, the R&AF, and BCAF. When it comes to gear space-age medical problems, Beckman is one of the most good faith companies in the world. For complete information on Beckman Biomedica, write to Dept. M,

INSTRUMENTS INC., Fullerton, California

International Subdivisions: General Instruments, Munich, Germany; Divisione Sanitaria

ing the pressure bulkhead behind the cockpit, the front and the back of the instrument panel. Anox, which weighs only 1.5 lb., will protect the crew from small leaks around the during low level missions. Anox can be made in emergency panels, but the emergency would prefer to stand it permanently during an emergency situation, since the weight penalty would be significant when the aircraft is being used solely for training.

•**Interchangeable G model instrument panel** which has a single selector sight mounted in front of the pilot, an instrument control panel and a terrain avoid, area indicator. To speed the conversion from trainer to fighter configuration, two instrument panels will be supplied with each aircraft. The switches from the A to the G version, the A panel will be removed and the base flight instruments will be taken from it and installed in a G panel, already equipped with the additional instruments required for the attack mission. While this is being done, the weapons racks will be installed in the aircraft. The G panel will then be installed in the cockpit.

•**Removable nose cone** which will contain a General Dynamics Corp. terrain avoidance package and additional navigational instruments for IFR operations. Nose cone on the A version will be an empty metal duct. Terrain avoidance system is a simple device which displays a target altitude with an indicator on a vertical scale. Prior to a new use, the pilot programs the desired altitude into the device and follows the indicator which shows entered in lag in the terrain at the given altitude. When the indicator rises, indicating higher terrain ahead, the pilot knows he must climb. Terrain avoidance gear will make possible all-weather and night operations.

•**Radar test packages** which will fit into the fuselage "add-on" equipment and will make possible ground attack in three dimensions: terrain, altitude, night. High resolution terrain, which can be fed forward to light the nose ahead of the aircraft will make it possible for the pilot to illuminate a target and attack it on the nose away.

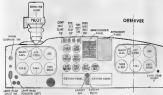
Attack profiles developed for the counter-air warfare version, which will have a maximum gross weight of 9,116 lb., will be a variety of approaches to target areas with the fuel being long range at altitudes of 300 ft. and speed of 400 to 450 mph. This speed and altitude range can change to give the pilot optimum protection from ground fire and yet give him time to attack his targets.

Attack missions could be done with a one or two man crew. The crew members could serve as a combination copilot, navigator and observer. During takeoff or observation missions, stable flight could be maintained in about 9°

CL-41A INSTRUMENT PANEL



CL-41G-3 INSTRUMENT PANEL



DIAGRAMS SHOW interchangeable instrument panel for CL-41 conversion packages.

graph with full external stores and 50% fuel.

Provision also has been made to adapt the CL-41G for dual aircraft tactical support operations (SATV) being developed by the Marine Corps (AFV One 56, p. 47). Canopy and bulkhead attachments can be jettisoned on the overline stations with no major modifications. Tailrotor distance of 230 ft., clearing a 58-ft. obstacle, is incorporated with the G version at its maximum gross weight.

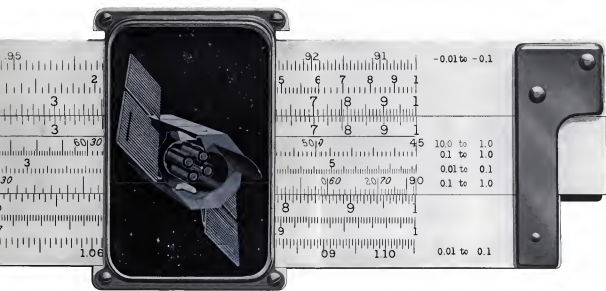
The same 141 payload will be used in the observer, but as after burner will be provided an optional component to give added power boost during operational missions.

CL-41G's photo mission conversion will be performed in the rear fuselage as the G conversion. Packages will be required for altimeters in less than 12 ft. Included will be camera packages for the nose and the centerline stores rack, flip tanks and sighting tools mounted on the wing stores racks and a separate instrument panel with a camera control and a Terrain map display device.

Camera packages will carry a variety of cameras built by W. Vinten, Ltd., of London. A vertical-oblique package containing three Vinten F-91 cameras will be designed for quick exchanges in a compartment just behind the nose wheel well. A quad-camera body with two Vinten 573 vertical cameras is being developed primarily for use as reconnaissance, target finding, but it could be used on operational missions.

The first external fuel tanks will give the CL-41G a maximum endurance of over 4 hr. Typical photo-scan missions also will be flown at 300 ft. and at the 400 to 450 mph range. At this altitude and speed, a pilot could photograph a strip of terrain over 4,000 ft. wide with the three-camera nose package. Camera speed will be a constant five frames a sec. with a 10% overlap of coverage. Missions could be flown alone or with as observer in the rear seat.

Cost of the CL-41 and its instrument packages will vary depending on the number of camera capabilities and the amount of extra equipment desired. Price of the basic CL-41A fuselage will be \$195,000. Price of the same aircraft



EMR electro-optics make space

EMR progress in electro-optical techniques may soon transform satelliteborne television into a basic tool for space research.

Special developments for Project Celestiscope, the Smithsonian Astrophysical Observatory's portion of the NASA Orbiting Astronomical Observatory, are typical of EMR's achievements. For Celestiscope, EMR has developed an ultraviolet television photometric system of unrivaled versatility. Consider these features:

New developments in UV techniques. Large precision optics, coupled with highly sensitive UV television detectors, will give astronomers their first comprehensive all-sky stellar survey in four broad UV bands ranging from 3000 Å to

1500 Å. EMR's electro-optical technology will compile UV profiles of more than 100,000 stars into a new map of the heavens. Hot stars down to 12th magnitude will be observed in a one-year earth-orbit program.

Choice of digital or analog TV. The EMR system permits accurate real time data acquisition by the use of digital television techniques coupled with PCM transmissions. Alternate operation is provided by digital storage of the TV data, followed by PCM transmission on command. A conventional, slow scan analog TV mode is also provided.

Flexible command and control system. EMR equipment permits manual operation of the four camera system via ground

television as versatile as a slide rule

commands; automatic remote operation via on-board stored commands; or automatic real time operation via ground computer command-control.

Unprecedented reliability. There is better than 99% probability that Celestiscope's electronic system and at least one TV camera link will operate successfully for one year in orbit.

Difficult problems in surveillance or reconnaissance, long-range restricted bandwidth video systems, and electro-optical measurements in any part of the spectrum are EMR specialties.

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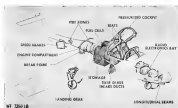
Here is a completely new concept in liquid level sensing. United Control's unique Thermal Point Sensor, now in production, offers greater reliability and simplicity, less instrument weight and power consumption, and lower cost to any vehicle utilizing a cryogenic propellant than ever before. The secret is a solid-state thermal-electric principle, adapted for the first time to liquid instrumentation. This principle allows United Control to measure propellant level on board to an accuracy of 0.03 inch... assure propellant utilization accuracies of better than 0.1%... and bigger an engine cut-off signal in less than 10 milliseconds. □ United Control has the time-tested capability to produce complete systems for determining propellant utilization, precise propellant residuals, and for providing telemetry and aloft instrumentation. Its propellant management, as in the many hundreds of control systems that bear the UCC trademark, reliability means success. For additional data on the revolutionary 2543-1 Thermal Point Sensor, or any of the family of flight, propulsion, temperature and environmental controls, and accessory systems and components, call United Control: serving the aerospace industry.



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[illegible]

GL-414 COUNTERINJURY protection will carry 750 lb. per peak water stress.



BASIC CL-41 AIRFRAME features unusual design and self-healing system

Definite plans have not been made as to how many different CL-41 packages Cummins will offer prospective customers, since each order may vary with the customer's requirements. The interdependence of components will permit future production of any, one of the three configurations, however, without the economic penalty.

Viability of the basic CL-41 design has been demonstrated with the CL-41R advanced system trainer—one of two prototypes currently being flown by Convair. The CL-41R has an F-104C nose section filled with the Lockheed NASARR electronic system and carries the NASARR electronic package in the aft fuselage "saddling" compartments.

was prototype. The other prototype, an A model trainer, is converted to an extended test program for the Condor Air Force, which has purchased 150 of the aircraft for its transport fleet.

The R model prototype also is slated to be a Canadian Air Force test program to check out the F-104G system installations, but it should be released by May. After a two-month test of Range, during which Canadian will demonstrate the advanced system trainer in NATO system scrubbing with the F-104G, the R prototype will be referred to Canada for comparison

In addition to its versatility, the GL 41 has other basic features which Caradon thinks set it far apart from its rivals. These are areas where counter-measure missions will be flown. These include the following:

• **Maintainability**, aided by the low-drag configuration which puts a majority of the aircraft's systems within reach of a man standing on the ground. All function disconnects and address back, giving clear access to the engine and its accessories. Other advantages are grouped in easy-to-reach compartments. Four maintenance manholes are equipped for every inch of flight, giving the CL-41 an hourly opening out of about 542, based on an annual equivalent of 500 h. This cost-effective design maintains and electronic support team.

• **Modularity**, made possible by the modular construction which permits disassembly of the aircraft into four major pieces, the main fuselage and powerplant, the wing assembly, the rear fuselage and the tail plane. Two men can assemble the CL-41 for flight in 10 hrs. Components are easily stored for an extended period.

Beeing Co. is using open type which casts at some temperature to improve load distribution in 737 transport body uppers and don'tlers and to reduce the need for increased skin thickness at some areas.

Tape adherent, developed to Boeing specifications by Shell Chemical Co., of Pittsburg, Calif., is called Epox Adhesive 917.

Epox 937 consists of an epoxy resin and a curing agent incorporated into Q995 in glass cloth tape. Impregnated tape is overlaid with job-offshore film and refrigerated immediately after manufacture. Tape is shipped in dry ice and held to -160°F until arrival. Storage life is about 45 days.

Adhesive is also used for overfill bonding of crowns used as free stop pins and for bonding built-up doublers and reinforcement.

In use, metal surfaces to be bonded are thoroughly cleaned and coated with a liquid adhesive well in advance of tape application.

For bonding two stoppers to each other, sections, double it and over tape with 45° tension to each other to it. Double it then bonded felt length to aluminum clad alloy body skin. Entire assembly is vacuum bagged and cured at room temperature for up to three days. As usually, can also be heat cured at 1400 for 90 min.



RELIABLE AIRBORNE MISSILE LAUNCH POWER

When maneuvering in supersonic combat, a fighter seldom has more than a few seconds to lock on its target. Therefore, the F-40-E wing tip launcher power supply for the Lookheed F-104 must keep its electronic circuits under adverse conditions of shock, vibration, temperature and altitude.

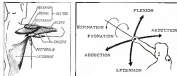
ITT has been building the F-40-E wing tip launcher Lookheed Launching power supply for the F-104 for more than three years. In addition to supplying launch power, it triggers the fire mechanism, activates the firing sequence, produces launch control, interlocks, and supplies radio signals to the pilot.



ITT for reliable airborne missile launch power. For further information, write Power and Space Systems Department for data file AW-100-2.

ITT

Industrial Products Division
A Division of ITT Corporation
4000 West 10th Avenue, Denver, CO 80202



ANTERIOR, MEDIAL AND POSTERIOR deltoid and pectoralis muscles (left) as found to control arm movements (right) in study of neuromuscular hand control system. Knowing arm to make hand, identified as separate and precise, will be investigated in next phase of program.

trigger and together the two circuit types form the basis for binary control logic matrices.

The logic matrix determines which muscles are contracting (supplying signals) and, on the basis of predetermined trunk tables, which way the arm is to move. Necessary signals are then supplied to drive a motor which in turn drives the arm. Time delay from system of muscle contraction to turn drive of the arm is about 0.2 sec., compared with an estimated delay of milliseconds for neural arm response following muscle contraction, Dr. Nussli said.

Before designing the control logic for the criteria, the group had to identify individual muscles, or muscle tone of muscles, involved in arm movements. Rotational (flexion-extended), flexion (upward), abduction (downward) and adduction (downward) were movements of primary interest on the assumption that the manual spacecraft controls would be situated over a sphere and surface must not be a pilot's hand with his arm completely extended.

Of arm muscles anatomized, four in strong consideration were found to be involved in the arm movements. These are the anterior, medial and posterior deltoid and pectoralis muscles. With these four, binary logic tables were derived for the system. Typically, upward motion is initiated when the anterior deltoid muscle site contracts, supplying a signal to fire the Schmitt trigger, changing its state. The upward motion occurs providing the other three muscle sites are not contracted at the same time. Downward motion is initiated by simultaneous contraction of both medial and posterior deltoid muscles and not the others.

Using college engineering students as subjects, the group conducted a series of simulation tests. Each subject was instrumented with electrodes over the shoulder muscle sites and electro-sensory signals generated in a voltage signal conditioner and computer control logic on the test stand.

The three types of simulation tests, or trials, were:

• **Static task simulation.** Subjects learned to contract proper muscles to move their arms in four directions. This task, divided into the control logic. The learning period apparently was brief, the ratio of successful movements to the number of attempts was swift, then decayed as the subjects began to tire toward the end of four days at four-hour shifts and were unable to contract the proper muscles.

• **Dynamic task simulation.** Arm splint was moved up and down on a track. After one to two minutes, the subjects were able to control it and their movements of the arm splint as the beam moved up and down.

• **Manipulator task.** This task attempted to evaluate the ability of the hand to perform simple manipulations, such as depressing a toggle switch that turned a light on and off and turning a variable potentiometer knob that controlled the brightness of the indicator light. The subjects were required



SUBJECT, WEARING VEST containing dip electrodes and amplifier, is prepared for experiment.



Can you think of a more punishing test for landing gear reliability?

Bringing a plane down on a carrier deck calls for a lot more than an ordinary amount of steel strength. Nevertheless, the shock absorber demonstrated here is designed into every strut we build—whether it winds up as a carrier-based lighter or a land-based bomber.

That's one reason our struts meet the most exacting en-

gineering specifications. One reason Bendix supplies struts for so many military aircraft.

Bendix® struts are high in strength, light in weight. They are designed with special emphasis on durability, reliability and economy. May we tell you more? Write to Airframe Equipment Sales Manager, South Bend, Indiana.

Bendix Products Aerospace Division





THE START OF A NEW CONCEPT IN AVIATION:

The fitting together of this mammoth fuselage at Lockheed-Georgia marked the first major manufacturing milestone in the Air Force's C-141 StarLifter program. The project is proceeding ahead of schedule. This giant now transports the first airplane ever

designed from the start to meet both military specifications and civil air regulations. It will bring vast airlift power to the U.S. Air Force Military Air Transport Service — and it will offer commercial carriers airfreight efficiency not possible in ordinary

an airlifter designed for both military and commercial carriers

planes. The key to the C-141's value lies in its true airlifter design: straight-in rear loading on a truck-bed height cargo floor — and its 7,000 cubic foot clear cube cargo hold. Production of the C-141 is being carried out not only at Lockheed-Georgia —

but at subcontractor plants around the country where 60% of the aircraft is being built. The huge craft will roll out this August, and will fly in December.

Lockheed StarLifter



VIBRATION NEWS

MB ELECTRONICS • A DIVISION OF TETRON ELECTRONICS INC.
Representatives in principal cities throughout the world

MB's 31st Automatic Random Vibration System performs tests at NASA after 2 hr. checkout

The 31st MB multi-liter automatic random vibration system passed an exceptionally stiff test for reliability.



The unit was ranked in NASA's Goddard Space Flight Center, Greenbelt, Md. to meet a critical random vibration test schedule for the Explorer 15 satellite. After a brief 2 hr. checkout, it was performing the first test—a 3 hr. test to the design of the system and to the competence of NASA engineers. What's more, the MB Automatic Equalizer exceeded the purchase specifications upon completion of acceptance tests.

Reliability is designed into the MB Automatic Equalizer through its all-electronic compressor circuit. The circuit, which provides automatic gain control, has proved itself in a wide variety of electronic systems.

The MB Automatic Equalizer is easy to install and setup time is negligible. Equalization time is reduced to within 5 seconds. The result is savings in test time and labor in minor and stressful measurements that can easily reach many thou-



MB automatic equalizer of new control loop must comply. Shown: the 31st MB automatic random system is capable of 3000 cps.

sands of dollars per missile tested. Operation of the MB Automatic Equalizer System is extremely simple and can readily be handled by non-technical personnel. This system also provides higher test accuracy and variability. Equalization to 2.1 and 3.5 db is obtained and apparent automatically compensates shift in resonant frequencies and changes in amplitude. Normal frequency range is 15 to 2000 cps in 25 cps bandwidth; optional equip-

ment provides for 2000 cps bandwidth between 35 and 16,000 cps by single front panel selection. Probably the most important feature of the MB Automatic Equalizer to practical random test engineers is that the reliability has been thoroughly proved in service—and units are available for prompt delivery.

For detailed information on the MB Automatic Equalizer write to MB Electronics, 701 Whiting Ave., New Haven, Conn.

Bionics Research Activities Detailed

Los Angeles—Nature and range of bionics activities, which now provide accurate and engineering insight valuable to unique component design by yielding a better understanding of living organisms, are discussed by a brief sampling of government research and development researches conducted in recent months. Character of the efforts, researchers share the work and government agencies in recent years.

- **Vital Information:** Following an Lanza-Stanford Research Institute, Air Force Office of Scientific Research.
- **Profound Study and Documentation of Artificial Systems in Logic Elements of a Flight Control System—**Adaptive Inc., USAF/Naval Research Systems Div. (NSR).
- **Research on Effects of Variations in Components and Member Functions on Information Processing Properties of Neuronal Networks—**Service Bureau Corp., USAF/NSR.
- **Research on Microphysiological Systems—**Stanford University, Office of Naval Research (ONR).
- **Research on the Mechanisms of Nephritic Physiology—**Alameda Div. of Space and Earth Corp., ONR.
- **Research on the Application of Perception in Visual Problems—**General Atomics Laboratories, ONR.
- **Research in Chemicals, Internal Systems from Mammalian Nervous System—**General Electric, USAF/NSR.
- **Investigation of Sensor Properties—**General Electric, USAF/NSR.
- **Study of Biological Mechanisms in Information Development—**United Research Associates, Naval Research and Space Administration.
- **Research Studies in the Biological Design of Man-Machine Systems.**
- **Study of Nervous Networks in Learning, Memory—**Alphatech, USAF/NSR.

is that speeded arm movement, not hand, is the key factor in the system and that the light off-axis axes of motion performed successfully at speeds up to 50 deg/sec.

In moving through the hand manipulation, an operator in, out, up or down motion was isolated, suggesting that the instrumented muscles were not involved in any way in the manipulation tests.

To picture what electronic systems are like, Spaulding points out that typical electrical properties of electronic systems for numerous conditions of an accurate one made detected at this system, as a whole, had

bandwidths 5 to 1000 cps, bandwidth of continuous signal power 10 to 100 cps, amplitude (peak to peak)—2 to 3 volts, and a 100 cps bandwidth.

Spaulding's electronic nerve control was, he says, not limited by the Air Force, and in subsequent investigation will explain systems after this. The first system, the shoulder, the forearm and repetitive motion of the arm, motion of the wrist and elbow will be added. The system will be present with actuator mechanisms

utilized in the arm system, possibly carried on a chair in place of the test rig used in phase one. Besides its possible aerospace applications, Spaulding's experiments could have applications in other, particularly defense, particularly in tasks involving lower control motion design.

FILTER CENTER

• **Spacecraft Digital TV—**Research in advanced, three-dimensional color, and motion for transmitting TV data from manned spacecraft in deep space will be conducted by Electro-Nuclear of Research, Inc., for NASA's Naval Spacecraft Control center in a multi-stage digital TV. Digital communication models will be employed for transmitting TV pictures from deep space when power is at a premium because of its size, efficient use of communication bandwidth. Electro-Nuclear will provide power from solar power systems power from while keeping close orbit at earth receiving terminals at negligible levels. It will look into alternative of technology.

• **Solution Defers Low Communication System—**Two-stage low communication system which uses the technique of polarization modulation to double the efficiency of information transfer over narrow bandwidth has been developed by Air Force Research and Development of Systems Div. in Systems Research Section. The information is to be transferred in a modulated by pulsing the light beam in accordance with the modulation system. Work was performed under \$50,000 Air Force contract.

• RCA Shows "Electronic Pig's Eye"

—Device which operates in manner similar to that of a pig's eye which cannot see in the dark only those objects which present a threat to its well-being or are objects of permanent interest while filtering out all other objects seen by the eye.

The "Electronic Pig's Eye" is a device of American Electronic Eye, Inc., of Andover, Mass. The RCA, which has been working based on original specifications in the eye, are in accordance with the Massachusetts Institute of Technology, in 1955 was built under sponsorship of Electronic Technology Laboratory of the Massachusetts Institute of Technology.

The system of 100 million cells, corresponding to the eye in color and shape, which are interconnected optically by means of nerve fibers and photoreceptors. The first visual images, 1000 pictures, which were the initial output detector.

• New Type Miniature Tube Reported

—Development from phase I reported by operations at Massachusetts Institute of Technology (MIT) in 1955, a new type of electron beam passing through a fine screen present is reported to be more rugged and long-lived than previous types of microchannel tubes and to have greater power handling capacity.

NEW AVIONIC PRODUCTS

• **Miniature glide slope receiver, AN/ARNA-7** weighs under eight pounds, was designed to meet AGREEI criteria for both Navy and United States Air Force aircraft. Set weighs 30 pounds, measures 6.5 inches across, 3.5 inches high, 3.5 inches wide. Dimensions are 6.5 x 4.5 x 12.5. Manufacturer: Sparco Corp., Jackson, Mich.

• **Electronic beam modulator** for testing in testing electronic modulators can work at carrier outputs and pulse modulators with a maximum of 100 watts. Beam is focused in a spot diameter of 0.0005 in. and provides 10,000 magnification per square inch, according to company. Manufacturer: Hamilton Standard, Windsor Locks, Conn.

• **Vibration support type recorder**, measuring 15 in. dia. x 41 in. long and weighing 11 lb., is suitable for high stability at 1 in./sec. and 10 in./sec. and will type speeds up to 30 in./sec. Recorder can be used in a test in percent motion in a low cost instrument. Manufacturer: Pacific Electronic, 9750 Emerald St., Torrance, Calif.

COOLING SYSTEM

SURE, IT'S A "FRANKENSTEIN" BUILT WATER, BUT IT ALSO DISSIPATES THE HEAT RELEASING IT, BY BLOWING OFF STEAM. AT WTC, WE APPLY THIS "BOLD-ON" PRINCIPLE TO COOL LIQUID-PROPELLANT ROCKET MOTORS. WE MAKE THE THRUST CHAMBER OF OUR NEW EPON-BONDED, FILAMENT-WOUND MOTOR FROM A TOUGH, RELATIVE MATERIAL THAT LITERALLY BOLS ANKT UNDER EXTREME HEAT, THEREBY PRETECTING THE THRUST CHAMBER AND NOZZLES. RESULT: A LOW-COST, RELIABLE MOTOR THAT AVOIDS THE PERFORMANCE PENALTIES OF REGENERATIVE COOLING SYSTEMS, YET GUARANTEES 18 MINUTES OPERATION. THRUST LEVELS FROM 58 TO TENS OF THOUSANDS OF POUNDS. A STATE-OF-THE-ART DEVELOPMENT FROM UTC.



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A
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DIGITAL TRAINING DEVICES are teaching basic principles of digital computer design and operation and demonstrating basic mathematical concepts and being executed by several computers. Device 3010, left, now demonstrates basic flow diagram, performs digital logic operations, shift register and memory. Device 3000 right is a sensitive digital computer capable of being programmed.

Trainers Teach Digital Computer Basics

By Philip J. Klein

Series of training devices designed to teach the basic principles of digital computer operation and to demonstrate elementary concepts of Boolean algebra—the basic mathematics of computer design—have been developed recently by a number of companies.

One of the largest digital computer manufacturers, the IBM Corp., has developed the Digital Equipment Corp. (DEC) series of digital computer training devices. The DEC series includes the Digital Equipment Corp. (DEC) series of digital computer training devices. The DEC series includes the Digital Equipment Corp. (DEC) series of digital computer training devices.

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performed by automatic or semi-automatic operations. The device uses 4-bit switches, with corresponding logic gates and flip-flops. It can add, subtract, multiply and divide with operations carried out either at high speed under automatic control of a built-in clock, or manually at slow speed to enable the student to watch the operations.

To obtain feedback information, the device has a digital display. The DEC series includes the Digital Equipment Corp. (DEC) series of digital computer training devices. The DEC series includes the Digital Equipment Corp. (DEC) series of digital computer training devices. The DEC series includes the Digital Equipment Corp. (DEC) series of digital computer training devices.

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in basic electronics. Instructions for making the separate plug board interconnections for each experiment are explained and reasonable care is followed until the advanced experiments are reached, when more is expected to work directly from documentation diagrams.

The second introductory manual introduces the student to the basic logic elements and how they are connected to form a variety of logic functions. The student can be connected to a variety of logic elements and how they are connected to form a variety of logic functions. The student can be connected to a variety of logic elements and how they are connected to form a variety of logic functions.

These experiments point up the fact that regardless of the digital logic design, the student can be connected to a variety of logic elements and how they are connected to form a variety of logic functions. The student can be connected to a variety of logic elements and how they are connected to form a variety of logic functions.

And the next is introduced in the flip-flop which is the basic of digital logic. The student can be connected to a variety of logic elements and how they are connected to form a variety of logic functions. The student can be connected to a variety of logic elements and how they are connected to form a variety of logic functions.

The basic, number system next is introduced in greater detail and experiments illustrate the basic logic elements and how they are connected to form a variety of logic functions. The student can be connected to a variety of logic elements and how they are connected to form a variety of logic functions.

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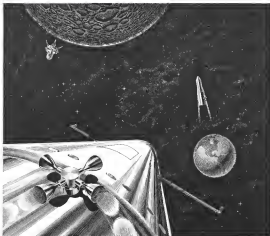
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New rocketry employment opportunities at Marquardt

Marquardt engineers have made significant technological contributions toward the development of precision controlled rocket systems as the result of company sponsored efforts initiated in 1958. Within a five-year period, these advances have made Marquardt a recognized leader in the rocket control field. During the past twelve months the Company has been awarded contracts on some of the Nation's most advanced space programs creating exceptional opportunities for engineers and experienced engineers and scientists. These programs include:

Project Apollo Service Module—reaction control rockets

Saturn IV E—alt-az rocket stages

System II missile—reaction control system

Growth-type opportunities are also developing as a result of participation on reaction control system components for the Apollo Lunar Excursion Module, continuing company-sponsored research, and state-of-the-art contract activity.

As a graduate of sophisticated reaction control rocket systems—propulsion systems, combustion chambers, valves,

nozzles and support equipment—Marquardt offers an outstanding chance for advancement to engineers and scientists who want to develop professionally through association with a dynamic company well diversified in rocketry, also known as rocketing propulsion, and aerospace research.

The Power Systems Division, the organization at Marquardt most directly concerned with rocket control and propulsion systems, has immediate openings for men with exceptional experience—any hours who have a demonstrated technical capability. If you hold a B.S. M.S., or Ph.D. in Mechanical Engineering, Aerospace Engineering, Physics, or Mathematics, and possess an engineering background in rocket action and control systems controlling propulsion, mechanical controls, propulsion cycle analysis, aerodynamic development, test instrumentation, or test operations, you are invited to send your resume, in confidence, to Mr. Floyd Hughes, Manager, Professional Personnel, 37000 Highway South, Van Nuys, California. Marquardt, an equal opportunity employer, is dedicated to keeping the United States first in technology.

THE MARQUARDT CORPORATION



RAYTHEON AS WORK

New Raytheon radar-TV helps FAA give added security to air travelers

Every time you or your loved ones travel in the U.S. by commercial plane, that Raytheon radar-TV helps under the watchful radar eye of the Federal Aviation Authority see trouble averted. Now the FAA can look ahead to you even more effectively, thanks to new "bright display" equipment developed by Raytheon.

The FAA's air traffic control system—which has long included Raytheon remote radars—guards the safety of air travelers by keeping a close check and screen view of all the speed, course and altitude of planes in flight. And the new "bright display" line of 30 installations—pays the radar operator a reliable new tool for monitoring your flight.

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McNamara Explains TFX Award Decision

AEROSPACE WEEK & SPACE TECHNOLOGY

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the passenger and cargo loading



Four flights of Sikorski S-64 Skyraiders with air crew and personnel via hoist plane retrieval at Sikorski Aircraft Seaford Coast. Roundside via air transport of troops. All three in 35 commercial passengers. It can also be converted to serve as a portable field hospital (surgery station in command post). Side doors and tailwalk (climbed) doors enabled the station of use (off) can serve for passengers and cargo loading.

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A revolutionary technique for transmitting

An important new advancement that is destined to have far-reaching effects in the ease and reliability of high speed data communications is now commercially available. Conceived and developed at Lenkurt Electric, and described below, the DBC is a recent technical paper, this breakthrough doubles the maximum rate at which binary data can be transmitted through a channel.

The new technique, called Duobinary Coding, permits high speed data communications with equipment hardly more com-

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binary data at twice the normal binary rate

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only replace the F-105. At the time, the Navy was designing a second tactical fighter to replace the F-4H in its fleet as defense aids. There are plans to build two more common aircraft and repair, now, was operational capabilities. After consulting with the military, and various aircraft and independent study, I became convinced that a new tactical fighter could be developed that would meet both the Navy and Air Force requirements. Accordingly, I directed that the Air Force, however, in progress with Navy participation, to select the goal of a common tactical fighter.

The concept of a single, multi-service aircraft system is new. I would be less than modest and say that I did not select the concept of a single, multi-service aircraft system as the Navy and Air Force said it couldn't be done. As far as the end of August 1961 after the Navy and the Air Force had been working to make the aircraft might actually it was expected to be in both services that development of a single, multi-service aircraft system was not technically feasible.

While the attitude, based on years of past experience, was not unreasonable, I did not consider it was a viable approach, considering the complexity and individuality of the aircraft to build into a modern aircraft because of advances in technology. I was also convinced that if we could achieve a single tactical fighter, we would save at least one billion dollars in development, production, maintenance and operating costs. In short, after study and review, I believed that the development of a single aircraft of generic tactical ability, to both services in the proposed time frame, was technically feasible and economically desirable. I directed that we continue to work toward this objective because the decision was probably not one I kept would fully achieved of the development of the F-15 as it progressed was the necessary 14 months.

Many I consider it seemed to be a thorough understanding of the matter before me. I would like of this point to present the view of some detail the sequence of events which led up to the decision. The 1 September, 1961, I directed the Air Force, to ask to develop a single aircraft for both the Air Force tactical aircraft and the Navy fleet as defense means. From the outset, the emphasis was on development of a common system that provided maximum compatibility between the Navy and Air Force systems. A specific guideline on this regard was:

"Changes in the Air Force tactical aircraft of the time, namely to achieve the Navy mission, and to be able to use the same aircraft, is a working theme throughout the program since aircraft which belong to both services were selected in October 1961, and the program was submitted by the Navy two months thereafter."

A survey, selected board was organized with members represented by the Navy and the Air Force and they were instructed to work jointly, in evaluating the proposals, under the same working conditions of the command of the Air Force Operational Systems Division.

It was the source selection board in selection group was established, consisting of approximately 215 Navy and Air Force officers, advisors and consultants, divided into teams to make the selected members



F-104s to Be Used in Astronaut Training

Three Lockheed F-104A Starfighters will be modified to enable configuration as a trainer concept and will be used for astronaut training. Designed NF-104A, the aircraft will incorporate jet action controls for maneuvering in atmosphere, no need for movable surfaces to "bite." Right controls in the wing will help maintain pitch and yaw control, and four others in each wing tip will provide lateral control. All jet action controls will be fed from a hydraulic pressure tank in the nose. Starfighter AIR-104A, modified aircraft, modified about regular jet inputs will through additional thrust for extreme high altitude operations. Aircraft, to be assigned to Aerospace Research Pilot School at Edwards AFB, Calif., will be normally between 170,000 and 180,000 ft.

and to evaluate each of the proposals in the area of technical design, operational efficiency, and maintainability of the aircraft.

The findings of the evaluation group were submitted to the senior leaders board. The board's recommendations were received by appropriate commands within the Navy and Air Force, as well as the Air Force, the Chief of Staff of the Air Force, and the Chief of Naval Operations and both, for the leadership of the Navy and Air Force, also made their recommendations to me.

On the proposals considered as the control and design, those of Boeing, General Dynamics, and Convair were selected in the evaluation group to be representative, better. But it was recognized that each of these designs would require additional design before it would be available. Although the Boeing design was given the highest rating in operational capability and General Dynamics was given the highest rating in the technical area, the evaluation group recommended that study continue to be conducted in both Boeing and General Dynamics, in order to enable them to meet the military requirements.

One example, Boeing proposed had offered the General Dynamics design to be modified to be compatible. The senior Navy member of the evaluation group stated that since the design was available without such substantial change.

A different view was expressed by the senior Air Force board member who recommended that further work to achieve a satisfactory design be conducted exclusively with Boeing. It was agreed that substantial changes had to be made in the Boeing design. A different group was organized, the design of Boeing members was available, the other submitting required actions and feasibility of substantial changes for the

senior board had proposed that a letter request be issued to Boeing for the limited program of evaluating a design configuration which would be acceptable to the Navy and the Air Force. The board's recommendation is contained in the Fairchild Air Command, the Air Force, together with command and the Navy Board of Operations. The Air Force, however, however, which would have been all responsible for the development of this aircraft, return would against the selection of Boeing and General Dynamics, in order to be both Boeing and General Dynamics, in my opinion, for the evaluation group.

The Air Force, General Dynamics, in the Department of Defense, to be selected in the absence of the Navy Chief of Staff, with the consensus of the Deputy Chief of Staff of Operations for the Air Force, after any period the evaluation group and recommendations that study members be made to both companies, in an informal comparison, the results of the study. The contract assigned that neither the Boeing nor the General Dynamics proposal, as submitted, would meet the established and new requirements.

The board still felt in attending the comparison in the additional period, "some" and others are thereby made up to be used (first test in the long run). It was concluded that negotiation should proceed, including the evaluation, in the final view of the results of the evaluation phase, and in all probabilities an order had to be made.

Agreeing with the Air Command's proposal, the Committee of the Navy and Air Force recommended to me that study results be awarded to both Boeing and General Dynamics.

This point on both:
• The proposals of these two companies were mutually agreeable to the others and

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elaborated the last chance of being brought up to standard service requirements.

The service was anxious to receive the General Electric design (in which the Boeing design had been built) because of the low probability of its development as the time required was not out a proto type needed at the time.

The extension would permit the fabric use of two designs and provide the same for the design companies. The Boeing design had been built because of the low probability of its development as the time required was not out a proto type needed at the time.

It approved the recommendations of the Secretary of the Navy and Air Force, and the other services about the status of the Boeing and GE designs.

The two companies submitted new proposals on Apr. 1, 1962, and the second evaluation was conducted in April and May. The evaluation was concluded that both companies had done a commendable job in conducting detailed designs, but neither design was acceptable to the Navy from the standpoint of reliability, but also a serious concern and delay in terms of status for subsequent periods of time.

The selection of options between the Navy and the Air Force design were fully in the hands of the Navy. The Navy member of the board took the position that neither Boeing nor the General Dynamics design was acceptable to the Navy member of the board. The Navy member of the board took the position that neither Boeing nor the General Dynamics design was acceptable to the Navy member of the board.

The Navy member of the board took the position that neither Boeing nor the General Dynamics design was acceptable to the Navy member of the board. The Navy member of the board took the position that neither Boeing nor the General Dynamics design was acceptable to the Navy member of the board. The Navy member of the board took the position that neither Boeing nor the General Dynamics design was acceptable to the Navy member of the board.

Therefore he was of the opinion that "it is possible in the future that the Navy member of the board will be able to select a design that is acceptable to the Navy member of the board."

The Secretary of the Navy and the Air Force agreed that the Navy and the Air Force design were fully in the hands of the Navy. The Navy member of the board took the position that neither Boeing nor the General Dynamics design was acceptable to the Navy member of the board. The Navy member of the board took the position that neither Boeing nor the General Dynamics design was acceptable to the Navy member of the board.

At the end of the two-week period, both companies submitted proposals which contained very substantial changes from their own designs. The Navy member of the board, which had been named every member that order of the new proposals met the Navy's requirements. The board also noted that the degree of design

between the Navy and the Air Force was such that it would be necessary to meet Navy specifications had not been determined in the time available. Nevertheless, the board recommended that the Air Force, the Chief of Staff of the Air Force and the Chief of Naval Operations proposed that a single contractor design should be selected at that point to conform to a common design definition phase. The proposal was for the continuation of the design process pointed up the fact that the purpose for which the design evaluation was still had not been selected.

Following the second and third evaluation of the TFX, it appeared to me not only that neither company was meeting Navy requirements, but also that my personal goal was not accepted or not to be understood by the contractors or the source selection board.

That goal was to develop, at all possible cost, a plan to meet the needs of both the Navy and the Air Force. Therefore, the Secretary of the Navy and the Secretary of the Air Force decided that work be continued to establish detailed design data which they could better select in the probability of developing the respective systems into an effective weapon system acceptable to both the Navy and the Air Force.

The day decided that the design dispute between the contractors' cost proposals and the Air Force standards be resolved. Later they agreed to meet in order not to increase the number of the Navy and Air Force systems and by use of common components and systems.

To find any design as to the objective, I asked Deputy Secretary of Defense DeLoach to order to General Dynamics to be resolved. Later they agreed to meet in order not to increase the number of the Navy and Air Force systems and by use of common components and systems.

"I am sure that the Navy and the Air Force design were fully in the hands of the Navy. The Navy member of the board took the position that neither Boeing nor the General Dynamics design was acceptable to the Navy member of the board. The Navy member of the board took the position that neither Boeing nor the General Dynamics design was acceptable to the Navy member of the board."

The two companies submitted their new proposals in September 1962. These proposals were reviewed by the evaluation board and the source selection board which made its report on Nov. 2.

At the end of the report, I must be told to use again the general conclusion of the evaluation group which only related service to the Air Force with the conclusion of Naval Aviation Chief of



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2. The Netherlands—servicing Rolls-Royce Dart propellers on a KLM Viscount.
3. The Argentine—routine inspection of an Avon Sabrejet on a Constellation of Aerolineas Argentinas being discussed with a Rolls-Royce service engineer.
4. Brazil—Brazilian—A Rolls-Royce service engineer works on the maintenance of the Avon Sabrejet on the SAS Constellation.
5. Japan—routine inspection of the Dart propeller on a Boeing of All Nippon Airways.
6. Australia—service engineers from TAA and Rolls-Royce effecting a Dart propeller on one of the airline's Viscount aircraft.
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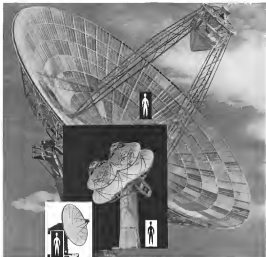
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designer engineers would be required under the production process. Supply and logistic problems become complicated. It is evident that the less the designer, the greater the savings in the logistic area.

These logistic savings are not susceptible of precise measurement, involving as they do such factors as training, logistic planning, future space rates, complex technical manuals and the like.

If I had approval of what was essentially true, different priorities, the progress of using one initial design would have been critical. The aim of antenna designers is fundamental. The effort to attain the highest possible degree of consistency lies at the heart of the entire TFX mission. My intention on this point was clear and consistent.

Another aspect of the Boeing evaluation report struck me as I reviewed the report and compared with my selected actions, including Dr. Chappell, who was then Chief Secretary of the Air Force and Dr. Brown, the director of Defense Research and Development. On the basis of my studies, discussion with my advisors, and my experience over the years in guiding development and production programs, it became clear to me that the General Dynamics proposal was generally more thought forward in approach than that of Boeing, although the General Dynamics design was fully acceptable. There were aspects of the Boeing proposal which on their face, complicated the development of the aircraft. Three problems in particular stood out as unusual. First problem was Boeing's proposed use of super-thrust engines for high takeoffs, as well as its reliance upon jet after landing loitering. On days of high gusts that mission has never been used in flight on operational fighter aircraft nor have they ever been employed on super-sound aircraft. The only operational experience has been on a Boeing commercial jet transport and transport aircraft in which the engines are mounted on a defined plane underneath the wings. The Air Force does have jet fighter aircraft in which a research and development type of installation has been made. There is a single engine mounted with the engine on the plane underneath and all of the fuel is taken. The Boeing design ran two engines angled in the fuselage with their nozzles extending both guns directly alongside the engine and angled outward, one above the other. The other effect of this two gun design is efficiency. Aircraft that lengthened and decked aircraft was not required could not be observed without engine light from in addition to considerable development and testing required. Since flight testing cannot take place until the design is complete, the Boeing design would require an added degree of risk in terms of waiting an early operational date for the TFX.

In addition the Boeing three engine layout, as the North Carolina report showed adds considerably to the complexity and the development risk associated with the engine. The fuel aspect of this problem could not be completely resolved because Boeing did not subscribe to the idea of the engine consuming fuel and "burning" as in proposed Ford's, which does not develop.

Spud: broken, as proposed by General

Dynamics, an inherently poorer and often a more straight forward approach to meet the stated military requirement. Since speed breaks will be developed around the engine, the engine will be required to meet the need of thrust at various points. It would appear that these possible advantages would be paid out in an increasing cost. General Dynamics proposal was to retain the engine to apply those resources to the aircraft design but we have the flexibility to substitute this development on an alternative basis concerning with the over all program, and remember all of this cost would be anticipated benefits.

The second area is the Boeing's approach toward likely to produce more, cost placed development product was its proposed power plant installation wing mounted rather. The North Carolina report commented that Boeing's location of the wings on top of the fuselage in combination with the Boeing solid engine design, results in significant distortion of the surface at the engine face under most conditions, and produces distortion during high angle of attack operation. The report noted that the effect of this distortion on engine operation is entirely responsible to engine performance. The Boeing design, however, in actual testing of the engine in flight under the distortion conditions derived by the reference section.

General Dynamics Design

In contrast General Dynamics chose a conventional design through "tailored" and solid design which the evaluation group concluded to be a good solution for the TFX aircraft, which should give the best trade-off in terms of performance, weight and operational problems. The proposed ideas also ensure the problem of engine inlet design during gusting conditions but does not require the belief that the more conventional General Dynamics solution for this problem will not be a benefit. It is one of the other uncertainties of the Boeing approach.

The third area is which the Boeing approach showed greater development risk as an extension of an aircraft as it is being over through structure. We have had some experience in the use of tension in other departments of our business applications and have high stress levels in thick plates are not avoided. The North Carolina report stated that this concern the fatigue design properties of titanium, in the thick, was highly apparent to me in the wing. The Boeing design is very large and that the more the question of the air resistance of wing such as the TFX. The report further commented that the effect of increased air resistance, density, speed, as in the discussion to titanium, which can be expected to be quite pronounced in production, the structural design, especially the Boeing longer leg program should be of value. In fact, Dr. Griffin, the TFX Project Director, Office, sent a letter to the engineering team pointing out that on the progress of the Aerospace Systems Division it was not advisable to use titanium in things which are subjected to burn, just as a heavy aircraft because of a lack of time relating to such use. If Boeing's proposed use of titanium did not work out and heavy steel



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had to be used to replace the lighter metal is indicated that not only would the open metal application of the Boeing plan, but for the additional costs would be increased.

In reality, the General Dynamics design solved the problem of wing loading for the expensive but easily replaceable of providing a bolt in each wing extension by the Navy version of the aircraft control of employing relatively normal applications of its metal metal.

These three examples point up for me a basic difference between the two philosophies underlying the two proposals I should emphasize. But this difference is philosophically was not possible in the hands of the Boeing engineers. Boeing had from the very beginning completely clear, more, however, only took up as an effort to achieve operational freedom which is called the required performance objectives. This approach was first exemplified in the early stages of the early-developed General Dynamics design for the aircraft.

If I did not want to see that the Boeing approach could be completely avoided. Do the contrary, I believed that the problem associated with the use of aluminum, the risk of threat sources in emergency flight and the high load stresses in the possible system and all materials, to be a real problem. But as proposed solution in the hands of the Boeing engineers, which indicated that these proposals would in fact solve the development problems, and would require a significantly greater development effort in the response by Boeing to these solutions.

Development Effort

But, significantly, Boeing proposed a development effort less than that proposed by General Dynamics and this in spite of the greater complexity of the Boeing aircraft design. The greater development between the Navy and the Boeing version of the Boeing version, and the large expense since which this position is building high launch weapons, light aircraft that would cause me to consider other and more of the Boeing proposal.

I discussed additional evidence of an attitude not consistent with the Boeing proposal. In the judgment of the conclusion, Boeing was more aggressive in its attitude of production freedom and design freedom, but in considering the manufacturing team for both the development and production phases, it appeared to me that Boeing would not not consider the complexity of developing the TFX. That of an understandable because Boeing's past experience in aircraft development and production has been with bombers and transport aircraft—complexities which is highly applicable to the TFX situation.

I believe concluded that as to the third cardinal guideline—domestically capable understanding of multi-design proposal was difficult.

This reference time and advantages are spread out in the fact. This attempt to spread out is by using Boeing's work to a full check in the development is more accurate. This also had advantages for the General Dynamics, and evidence which was considered difficult, but not really a much as a Boeing.

The TFX version applied experience and other critical factors to the

two proposals in an effort to make it all more costs. The application of such factors is not useful in the context of an inherently less proposal. Where, however, the less proposal is the result of a lack of an acceptance of the complexity of a problem, the adjusted figures are subject to such critical review.

Expensive matter was the real and nature of the situation. Boeing would not have an equal understanding of the problem by both Boeing and General Dynamics, and their reaction to the cost proposal was in less moderately. But the possible result of the lack of appreciation of the steps of a particular design, increased costs. The extent of which a contractor's responsibility and therefore not acceptable to extend by the application of standard guidelines.

Importance of Costs

The question has been raised as to why they are not important to both contractors who preparing detailed, accurate cost items. There are several reasons.

One is development contract. For a cost plan was a separate matter for the TFX, then availability will be engineering change orders. The cost of change orders is borne by the government. Consequently, in the two proposals, both more military typical, standard and Boeing, and General Dynamics, the proposals which were based on constant the pace of the production program a lack for all practical purposes could be considered in the development contract, but would probably be affected.

Another factor is the TFX program, was an ongoing program. That is, so great as to be an important element in its own right, it must be considered in its own right.



Japanese-Built J79 Engine Tested

Mitsubishi Heavy Industries of Japan, former a subsidiary of the General Dynamics F-119B being produced by Japan, has successfully completed a 170-second endurance test of the J79 engine. The engine was manufactured under reduced licensing agreement with International Group Electric Co. The engine is planned to manufacture 75% of the components and the J79. At present, 85% of the parts produced on the engine are Japanese-made.

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project priorities in the two-year study and the more thoughtful design of General Dynamics as industry contractor still scored in the design department, and protection of expensive fighters and aircraft by General Dynamics' continuing design development, and product of Navy contract award offered a more dependable service to us.

I have doubted at times length the reason making any judgment that the General Dynamics proposal offered the better possibility of obtaining a satisfactory result on the drawn time schedule and within the dollar program.

Having noted that the TFX question over many months I met with Deputy Secretary Galt, Secretary Keith and Secretary Zerkow only in November 1981. I found that their own views were not independent, I consulted with me. After several discussions we concluded.

First, that if the evidence showed that the TFX concept was a valid concept that would markedly improve existing military capabilities of the Navy and Air Force. The decision should be made along with the development of the TFX aircraft.

Second, on the part of the Navy, the Navy would lead in the contract, we chose that General Dynamics should receive the award. Although I considered our position to be weakly supported on the final issue, I have decided. I agreed that Mr. Zerkow was to review the facts again before we arrived at a final decision.

Having reached an agreement on the TFX concept, we decided to award TFX development contract to General Dynamics.

There remains one issue important in part of the case which I believe should be thoroughly investigated. Presumably, we are dealing with a system of policy, not a system of policy. General Dynamics is not a system of policy, not a system of policy. General Dynamics is not a system of policy, not a system of policy.

In the case we are faced with a situation in which judgments are presented for judgments. First, not have the judgments of the competing companies but as an example of general design can be built at a price that makes a specific issue for Navy, we have the judgments of the production group regarding feasibility, and the design to which the design would be used to satisfy the stated requirements. Thus, the same situation could arise from weight by judgment, make a comparison which appeared to place greater emphasis on political issues factors in our own operational area, rather than on the feasibility of development and production of the system. The requirements, underestimation, not revealed by the Navy and Air Staff, since these factors are most likely, and in the future, the situation in production is individual response factors.

On occasion, this does lead to the establishment of characteristics in a system which cannot be met until the time of final review, and for frequently resulted in learning operational objectives.

There is only one way I know to know about the compounding of error that can occur through the presentation of judgment and that way is to apply the principle of the decision-maker not only to the final presentation but also to the underlying assumptions and facts. This is a lot to

the best of my ability. In doing so I found it necessary to believe the process is not by comparing estimates.

That I think great experience in the principle of that comparison is I believe, demonstrated by my estimate that comparison, coming through the program decision phase of the TFX project. That I think great experience in the failure of established military requirements, I believe, demonstrated by my estimate to terminate the program decision phase and I was not sure that the Navy and Air Force had been met. That I think great experience in the acceptance of economic and industrial requirements, I believe, demonstrated by my estimate that General Dynamics is the contractor that most clearly represents the interests of these two services in the task to be achieved.

I do not feel that this is a case which

prevents a continuing conflict but reflects one of the many programs which I must be placed in the final analysis, decisions defined. In making my decisions, I considered the recommendations of my various military and civilian advisors as well as other available evidence, but I had the final responsibility. The basic principle is, you get what you deserve, you get what you deserve.

• Both the General Dynamics and the Boeing designs met stated military requirements and would provide significant improvements in combat capabilities of the Navy and the Air Force.

• The General Dynamics proposal resulted in a massive divergence from a common design compatible with the separate interests of the Navy and Air Force, thus ensuring its substantial military superiority. As probably inherent in a joint project.

• The General Dynamics proposal selected a more serious and realistic approach to the Navy's defense needs.

As Secretary of Defense, my responsibility was not to choose the decision, but to ensure that the decision was made.

U.S. Drafts New Test Ban Plan Calling for Policing by Principals

Washington—Administration is drafting a new nuclear test ban proposal under which the U.S. will offer a U.S. 10-year moratorium on nuclear tests. The U.S. will offer a U.S. 10-year moratorium on nuclear tests. The U.S. will offer a U.S. 10-year moratorium on nuclear tests.

The proposal would reduce the role of an international organization, essentially, to that of a monitor and coordinator. Dr. Long emphasized the new approach to testing, "no more test and 10 years test."

Two basic points in U.S. position which will be reflected in the new proposal are:

- **Underground detection.** The system for detection of clandestine testing is

disputed would be characteristic with the U.S. and under U.S. control. The U.S. would maintain a system of about 15 sensor stations in the USSR. Each would cost about \$1 million and annual operating cost of the system would be about \$10 million.

• This contains the U.S. system of a world-wide network of 150 land and sea-based stations under international control and manned by personnel of several nations. Under the new U.S. proposal, no provision is made for the U.S. to maintain stations to be located near Russia.

• On site inspection. Administration believes and a reduction in the number of on-site inspections is anticipated as early as January 1982. From the 20 originally called for by the U.S. in 1978, it has reduced to 12 and then to 8—no reduction by treaty and political agreement. Russia has agreed to reduce its on-site inspections to 12.

Technical Core

The technical core of the inspection team under the new proposal would be U.S. or U.K. personnel, rather than the international teams of the Geneva plan. "One decision in this area has been to arrive at a technical core, but on the one hand, the technical core of the U.S. would be made by treaty and political agreement, not by treaty and political agreement, not by treaty and political agreement."

Dr. Long and Dr. Long considered some of the technical testing, but stated that no series of tests or tests that would have military significance could go undetected if the new Administration plan were adopted.

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Hovercraft Pact

License agreement for manufacture of Vickers-Armstrongs (Engineering) V.A.3 hovercraft has been signed with Vickers Shipbuilding and Engineering Co., of York.

Vickers currently is designing a V.A.3 model which could carry more than 100 passengers, V.A.3 version carries 75.

time in developing operational vehicle layout and loading arrangement.

Lord Fleckley's steel case under attack from Lord Shackleton, also charged.

"It is quite absurd to suggest that the need for these high quality scientists is the result of a failure in the American educational system. The fact is that this is a sufficient cause. They have more resources and are prepared to run large firms, to go out and buy the latest materials [the British scientists] have because of the opportunities for research."

Another host of British scientific life—the large research establishments maintained by the government—came under fire from Vacuum Calcutta, deputy managing director of British Aircraft Corp., also declined.

"It seems to me that there is a risk that we are not getting full value from the work done by the research and development employed in some of our government supported research organizations, owing to the inflexible establishment—establishments in the sense of main power allocation. For example, in many cases the commitment of five to ten technicians or clerical staff will be of much more value than the current support of two qualified scientists or technologists, and they will not roughly the same."

Research Work

In a reference to the importance of research work, Lord Calcutta cited the importance of the so-called "technological infant" from defense and space activities.

"...Very much of research is being spent in the United States on space research and exploration, in addition to the annual defense budget. It is one to conceive that expenditure as being wasted as being purely for profit for 'keeping up with the Joneses' but there is no doubt that the resultant benefits are striking and are leading to rapid advances in other fields," Lord Calcutta said.

Which means it is done Lord Calcutta is giving the British scientists last group alone in society like and "there is still a tendency to keep scientists out of the direct line of authority and decision-making in the government machine."

Julian Amery, the Minister of Aviation, claimed that the movement of scientists abroad from the aviation industry and the government research establishments was small. The government, he said, had lost only four men in this field in the last five years.

"Both in our establishments and in industry," Amery said, "our research scientists have had a challenging job to do and this has made up to a considerable extent any difference in salaries which we have been able to offer."

Taken Soundness

Criticism of engineering was not uttered in the House of Lords. The Earl of Hailsham announced that seven in the U. S. was involved in launching scientific talent.

Lordships of the British opposition Labor Party, Harold Wilson, said.

"If British industry gave as much support to the scientist as it gives to the television bubble and advertising manager, we should not only stop the drain overseas we should be winning out training abroad, in the case for technical appointments."

One American personnel consultant, David J. F. Ziegler, who represents ST Aerospace Inc. as Executive Director of General Inc., claimed that British scientists apparently double their salaries by comparison. The precise reason, however, is the opportunity for greater research facilities, he said. Two overseas shortfalls for scientists, each country about 1,175 copies, according to Ziegler.

Fourth Deep Space Tracking Station Set

National Aeronautics and Space Administration will establish a deep space tracking station close to the southwest of Calcutta, Australia. The facility will be the fourth link in NASA's deep space tracking network, which consists of stations near Johannesburg, South Africa; Goldstone, Calif.; and Woomera, South Australia. Research Establishment of the Australian Dept. of Supply will operate the station for NASA.

Manual space flight and scientific satellite tracking station (no will be built at Canberra, West Australia and Barrow, Northern Territory. These facilities will meet with tracking and communication for Pioneer Gemini and for other spacecraft from the Russian Orbiter, Geostationary, Orbiter (GEO) and the Orbiter Astronautical Observatory (OAO).

NASA Australia station is operated on the Feb. 25, 1966, space operation agreement signed by Australia and the United States which has been amended to specify new stations in Australia.

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WHO'S WHERE

(Continued from page 39)

Changes

Robert S. Steward, engineering manager and J. W. Owen, design coordinator, Long-Term/Volunteer's new ETV, Michigan De Witt, Mich.

Dr. B. H. Fox, Dr. Paul Rosen and Dr. George Kovach, scientific specialists in the electronics field, have joined the new research and advanced technology department, Martin Co.'s Electronic Systems and Prod. Serv. Div., Baltimore, Md.

Dr. Arthur Goldblum, chief engineer, Airline Communications Laboratory, Chicago (Ill.) Center, University of Illinois, Urbana, Ill., has been named the new program manager of Military Research, Army Research Office, Addition, Systems (RADAS) Program.

James H. Kestler, manager of systems and procedures, General Dynamics/Electronics, San Diego, Calif.

Feder J. Kofas, manager of electronic systems, General Electric Co.'s Computer Dept., Phoenix, Ariz.

Luckford Menden and Roper Co., Sunnyvale, Calif., has appointed the following managers to the RUT program: Ch. H. H. and R. Schuch, USAF, at language technology; Raymond J. Schuch, technology and support systems design.

Louis M. Pini, international marketing coordinator, Laboratory for Electronics Inc., Boston, Mass.

Charles Reich, chief of advanced planning, Bell Telephone Co., Fort Worth, Texas; Lawrence P. Shulman, director of engineering, Systems Div. of General Bell Telephone Co., Buffalo, N.Y.

Nello C. Iovanni, chief pilot of General Instrument Laboratory, Buffalo, N.Y., has been named John C. Smith, vice president of General Instrument Laboratory, Buffalo, N.Y.

John F. Risk has been named by the National Defense Science and Engineering Graduate Fellowship Program, Washington, D.C.

Richard P. Cahill, general manager of General Electric Co.'s Commercial Products Department, Commercial Service Div., Lynchburg, Va.

Hughes Aircraft Co.'s Tucson, Ariz., is appointing Liberman, has named responsibility for the TOW missile project and Edward J. Hays has been appointed manager of the Liberman and George H. Hughes, executive manager, Edward J. Hays, research manager, Tucson, Ariz.

Dr. Robert E. Kase, division manager, Fluid Physics Div., General Electric Co., Franklin, Calif., and General Electric Co. Research, Advanced Electronics and Information Systems Div., also Stanford R. Kestler, manager of systems for the Electronic Systems.

Dr. Edward B. Cummings, manager of the new sound technology Dept., Air Force, Falls Church, Va., a subsidiary of Westinghouse Air Brake Co., William H. Pater, research Dr. C. C. as manager of the Advanced Computer Laboratory.

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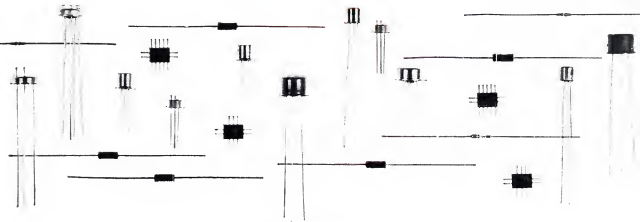
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